THE

ELECTRICAL REVIEW.

VOL. XXXVIII. APRIL 24, 1896. No. 961.

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TELEPHONE EXCHANGES AND THEIR WORKING.

THE article on this subject, which appeared in our issue of the 10th inst., was based on a careful and perfectly unbiassed reading of Mr. Sinclair's paper; an equally impartial summing up of the discussion supports us in the impressions to which we then gave utterance. As Mr. Kingsbury, who opened the argument, truly says, the controlling factor in the matter is not electricity at all, but simply anatomy, and his analogies must have convinced everybody, excepting Mr. Sinclair and Mr. Binswanger, that the upright board is the more get-at-able.

Flat boards are possibly cheaper than those of the upright type, but as the latter when once installed are serviceable for a great number of years, extra first cost is but a slight consideration as against the increased cost of operating flat boards.

Mr. Sinclair's comparisons generally were discounted to a considerable degree by an unfortunate reliance on old types of board, in which an operator attends to 50 subscribers, whereas at the present day it is no uncommon thing to find 120 subscribers allotted to one operator. Facility of working is the crux of the whole question, and Mr. Kingsbury handled his subject in a manner which leaves no doubt in the impartial mind as to the correctness of his deductions. Mr. Binswanger declared himself to be in cordial agreement with Mr. Sinclair, "and that in spite of the remarks of Mr. Kingsbury."

His experience, however, seems to be based upon the fact that he and other subscribers whom he had consulted *preferred* the call system, and not upon any special engineering acquaintance with the debatable question; but, as Mr. Kingsbury puts it, subscribers ought to be treated rather as children; they did not know what was good for them; the people who supplied them should be the judges of what they ought to have. Other of Mr. Binswanger's allusions were of the kind which are better left unsaid. His prettily turned compliment to Mr. Preece's work in the early days of the telephone is hardly in keeping with Mr. Preece's then definition of that apparatus, and it is a dubious kind of flattery to Mr. Sinclair to congratulate the telephonic industry on that gentleman having taken an independent course which will emancipate him from former practice, when it is clear that *his* practice is neither new nor good, and is gradually in process of abandonment elsewhere.

Mr. W. H. Preece, in a characteristic, able, and very practical series of running comments, was quite at one with Mr. Kingsbury in his objections to the flat board, and equally eulogistic of the merits of the vertical board, and the disappearance of all difficulties in connection with its use; but the engineer-in-chief of the G.P.O. prophesies the speedy disappearance of multiple boards altogether in all

big exchanges. Still that was not the question at issue, and as Mr. Preece has had the good fortune of seeing perhaps more of the working of the telephone than most people, we certainly think that, in the face of his statements of fact, the arguments used by the author of the paper and his supporter on both boards and call system, fell flat.

Mr. Addenbrooke's remarks were mainly to the effect that he himself is an old telephone hand, and that Mr. Sinclair might have given some credit to those who initiated the service he now controls. Mr. Hawes, who spoke with an intimate knowledge of his subject, and Mr. Somerville added their experiences, and with the one exception already mentioned, the upright board was hailed with the greatest favour.

Mr. Sinclair, in responding, gracefully alluded to the convincing manner in which Mr. Kingsbury had put his case, so ably, indeed, "that he (the speaker) began to doubt himself, and that was saying a good deal." And yet we do not know why he should, when one considers his peculiar definitions of the Law and Mann systems, which, as in the case of the rival boards, were thoroughly entered into years ago in the pages of the Electrical Review. Mr. Sinclair would not discuss the point raised by Mr. Preece of the difficulty of a man getting down to work amongst the wires of a flat board; they have, he said, to be trained to it—"they had to train a man how to behave himself, even if he was in close proximity to some one of the opposite sex." We little suspected that the male operators of the National Telephone Company were such Don Juans that it was necessary to teach them how to behave—to train the telephone Jacks to be chivalrous to the Jills—and when we say that the remainder of Mr. Sinclair's reply contains but little of a more convincing nature than this extraordinary simile, the strength, or rather weakness, of his case, can be fairly estimated.

The Future of Elevated Railroads.

It is questionable if there will be any more elevated roads built in the United States. So says Mr. Klapp in the *Engineering Magazine*. Upon the success of the New York lines followed the unsuccessful lines of Brooklyn and Chicago. The New York lines we may compare to an elevated line along the Strand and Fleet Street, but the Brooklyn lines are like a line from Euston Road to Hampstead, out of the great trunk line of traffic. If Chicago can hardly support its overhead lines—indeed, two of them have already gone down under their financial burdens—what city can hope to do that has not the particular character of New York. Mr. Klapp would alter matters so as to make elevated lines possible financially. The New York traffic was so heavy that it called for heavy and long trains at frequent intervals. The heavy trains have been copied by the other roads, and so the structures have been also heavy and costly, and, where traffic has been small, intervals have been made large and nothing kills traffic like a long interval between cars. People will not wait, and on the New York lines there is no waiting. Between a 4-car train every 6 minutes, operated electrically, and three 2-car trains at 2 minutes interval, the wages costs per diem are as \$8·10 to \$12·15. But the loads are as 87 to 48 tons, and yet the seating capacity is as 188 to 180. The saving in fuel and power house equipment will be one-half with the light cars. An elevated car of 15 tons only seats 48 passengers; a surface car of 4 tons will seat 26. Everything points to the better economy of light cars, and, undoubtedly, single cars at short headway, even with the extra wages bill, will secure far better results in traffic. A mile of standard elevated road costs from \$850,000 to \$1,235,000, whereas a mile of light line will only cost a bare \$300,000. The stations could be smaller and nearer together, and the intermediate traffic would be secured. A light road would be operated for little above two-thirds the cost of the heavy road, the chief saving being in interest charges, and the conclusion is drawn that, though a standard road may eventually pay well, it will be years before it does so, and a light line would pay at once, and before the heavy line had reached a good paying basis, the light line would be in a position to double up or to build another line in the next avenue or parallel. If elevated lines are to pay it will, we are assured, be along the lines indicated and with electrical operation. But there are few places in England where an elevated line could be built or tolerated. An elevated road has the disadvantage of its elevation in the form of staircases, and a good service of surface cars must always be a keen competitor, for short distance traffic especially. The elevated road is all that an electrician can desire in convenience of arranging conductors, but its structural cost is such that it is only possible along lines of dense traffic, and the lines of dense traffic usually impossible on other grounds, the line at Liverpool being a brilliant example to the contrary, but where in England can there be found a repetition of the conditions at Liverpool? In London there might easily be a paying elevated line along Whitechapel, and it would not be in the way in a good broad thoroughfare like that, and this is the only thoroughfare that suggests itself at the moment as fitted for the experiment.

Horseless Carriages.

The report of the meeting of the British Motor Syndicate, under the heading of "Horseless Carriages," in the *Financial News* of the 17th inst., is instructive reading to those interested in electric street vehicle traction—in fact, to all interested in the electrical industry. Those interested in pushing oil engine carriages evidently know how to pull the strings, and to crack up their interests. With this we have no fault to find *per se*; we are unaware to what extent the Syndicate in question are justified in announcing that they control the oil engine carriage trade, but we must demur strongly to the statement in the report of the meeting which says that "our patents do rule and control every substantial improvement in horseless carriages." Horseless carriages are worked by electricity as well as by oil and steam, and without going into the oil and steam section of the question from an electric point of view, we must point out that such a claim by the company cannot be correct. The chairman goes on to state that the company have, amongst their engineers and advisers, the "very best motor engineer in connection with horseless carriages;" the chairman supposed that the gentleman in question "has had more experience than anyone else in this country." Without in any way disparaging the work of the gentleman in question in connection with oil engine carriages, those interested in electricity cannot allow such a claim as this to pass by. The movement of recent years in connection with horseless carriages in England has been pioneered and stirred up by "electricity," not by oil or steam. No such experience as the running of an omnibus 5,000 miles through the traffic of London streets can be pointed to in connection with the oil engine carriages. It is the flag of electricity which has been carried in the van of this movement. In connection with this the work done by Mr. Radcliffe Ward is certainly to the advantage of all interested in electricity, and his extended experience in practically testing and running such a vehicle as an omnibus through the metropolitan streets is well worth referring to at the present moment.

TELEPHONY AND TELEGRAPHY.

It could be foreseen some years ago that telephony would little by little supplant telegraphy on lines not heavily worked. Already, on important lines, telephony is carried on concurrently with telegraphy with the aid of apparatus as simple as ingenious, enabling telegraphic despatches and telephonic communications to be conveyed simultaneously. We, writes N. Amzan in *L'Eclairage Electrique*, propose to discuss the possibility of utilising the secondary telegraph lines for telephonic conversations. This question is not so simple as it appears at first sight, and it requires to be studied somewhat in detail.

Everyone is acquainted with the plan adopted by the greater number of telegraph administrations for communicating with the smaller offices. It consists in grouping the secondary offices together two by two, as far as possible, on one wire. Thus, for instance, the telegraph offices, S_1 and S_2, are connected with the Government office, E, as shown in fig. 1. When the office, S_1, is in the path of the line, E, S_2, the derivation, D, S_1, is shorter, but the principle is the same. In both cases, the electrical resistance of the three branches, E, D, D, S_1, D, S_2, is equalised by placing on the shorter sections a suitable electrical resistance.

It is easy to understand the working of such a system. In the office, E, is a current-reversing commutator, which enables either a positive or a negative current to be sent from this station; in the offices, S_1 and S_2, is a polarised call apparatus. If the stations, E and S_1, communicate by means of the positive current, the polarised apparatus of S_2 being only influenced by the negative current, this latter office will not be affected.

We have now to see how this arrangement can be utilised for telephonic communications. There are two cases to be examined:—

1. One of the offices, S_1 or S_2, wishes to hold telephonic conversations with E in the interval between the telegraphic despatches; these are alternate communications.

2. When the number of telegraphic or telephonic communications seems to be too great, these two stations should be in a position to exchange telegraphic and telephonic communications at the same time; these are simultaneous communications.

I. Alternate Telegraphic and Telephonic Communications.

(*a*) When the secondary office, S_1, is the only one on the wire, the problem is very easily solved. We have only to instal a commutator and a telephonic set in each of the telegraph offices. And even the lightning arresters and the call bell of the telegraph office can be used for both the telegraphic and telephonic services in each office. Under these conditions, we should only have to substitute for the present two-way commutator a three-way commutator, bell, telegraph, and telephone.

(*b*) If, as is usually the case, two secondary telegraph offices are established on the same wire, and one of them, S_2, requires to use the telephone for the interchange of conversations with the Government office, the installation in the two offices, E and S_2, will be the same as the one above described. (*a*) But we must provide for the case in which the municipal office, S_1, having occasion to telegraph at a given moment, and not possessing any apparatus showing that the offices, E and S_1, are in conversation, might interrupt a telephonic communication.

To avoid this inconvenience, we have only to place in the circuit of the station, S_1, between the point where the wire enters the office and the commutator, any telephone whatever. Before signalling to the office, E, the operator at the office, S_1, would place this telephone to his ear to make sure that the line is not being used for telephonic purposes. However, in order not to add to the circuit of the station, S_1, a resistance that is useless and inconvenient for telegraphic work, this resistance might be placed at ordinary times on short circuit by means of a special key, K. When the operator wished to listen at the telephone to ascertain whether the line is free or not, he would have to place the telephone at his ear, and at the same time to press the key, K (fig. 2). Lastly, as the telephone is to be used merely to ascertain the state of affairs as regards telephonic communication between E and S_2, if, for reasons of discretion, it was desirable that the words interchanged should not be distinguishable in the office, S_1, the vibrating membrane of the telephone, F, would only have to be replaced by a thinner one. The telephone, F, would then be only the more sensitive to the telephonic currents, but as certain letters, such as i, u, s, &c. (French pronunciation), would not come out well, it would be impossible to follow the conversation interchanged between E and S_2. In other words, the sensitiveness of the telephone would have been increased to the detriment of its clearness.

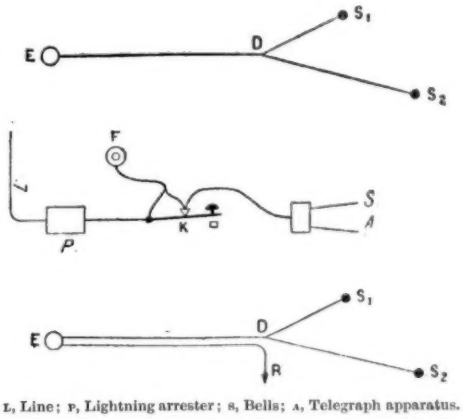
Up to now we have supposed the secondary telegraph wires, on which we proposed to correspond telephonically, to be alone on their supports. In cases where the whole or part of these wires are on poles, supporting other telegraph wires, it would be necessary to double the whole or part of the line to be used for telephony, in order to avoid induction from the neighbouring wires.

(*c*) We will suppose that the section, E, D, of the service represented by fig. 1, is on poles supporting several telegraph wires. In order to avoid induction, we should have to double this action by a return wire, E, R (fig. 3).

The installations at the offices would be the same as described above (*b*), the section of wire, E, R, being used only for telephonic communications.

(*d*) In the case where the part, E, S_2, is on poles supporting other wires, it is indispensable to double the whole section. Under these conditions the communications between the stations, E and S_2, would be those represented by fig. 4.

G is the telegraph office, and F the telephone office. As this figure shows, the return wire would only be used for telephonic correspondence. We may remark that with this



L, Line; P, Lightning arrester; S, Bells; A, Telegraph apparatus.

Fig. 1.—Diagram of Communications between a Government Office, E, and Two Municipal Offices, S_1 and S_2.

Fig. 2.—Arrangement of the Instruments of the Office, S_1, enabling the Operator to ascertain whether a Telephonic Conversation is going on between E and S_2.

Fig. 3.—Arrangement showing the employment of a Return Wire over the Section, E, D, on the Poles of which are several Telegraph Wires.

arrangement it would be no longer necessary to place a telephone with a short-circuiting key in the office, S_1, as the signals could no longer interrupt the telephonic correspondence between E and S_2; and besides, this telephone would no longer be in a position to indicate whether a conversation was going on, as the telephonic currents would be conveyed through a completely metallic circuit.

(*e*) If the two stations, S_1 and S_2, wished to communicate telephonically with E, each of the three stations would be provided with a telegraph office and a telephone office.

When S_1 or S_2 wished to use the line, the telephone office should be used, and it should first be ascertained whether the line is free or occupied.

Of course, it would always be necessary to double the sections of line established in the neighbourhood of other telegraph wires.

Up to now, we have passed over in silence a very important point from a practical point of view, considering the extreme sensitiveness of the telephone. This is the result in the Government office, E, of using the earth for the telephone when it has not been necessary to double the whole or part

of the wire. This earth is common to all the telegraph offices in communication with the State office, E. It seems that it would be indispensable to use for the single wire telephones of the office, E, an earth different to that of the telegraph lines. The distance to be allowed between these would be determined by experiment.

II.—Simultaneous Telegraphic and Telephonic Communications.

When two offices, E and S, are connected by two wires, we know that it is possible for them to correspond simultaneously by telegraph and telephone by using either the Van Rysselberghe, the Pierre Picard, or the Cailho system.

We give for reference the diagrams of these systems, leaving out the accessory apparatus.

The Van Rysselberghe system, which enables a telephonic conversation and two telegraphic despatches to be transmitted simultaneously, as if four wires were used (*c* is a condenser introduced into the circuit; the electro-graduators are not represented). Fig. 5 only shows the utilisation of one of the wires for telegraphy.

The Pierre Picard system, which enables a telephonic conversation and a telegraphic transmission to be carried on simultaneously (A, A', transformers, fig. 6).

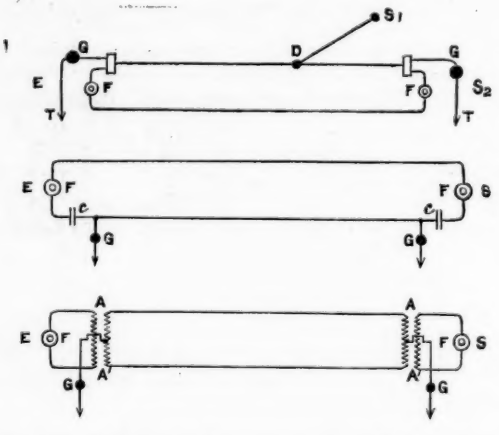


Fig. 4.—Diagram of the Communications in Cases where the Poles of the Line, E, S_2, Support several Telegraph Wires.

Fig. 5.—Diagram of the Van Rysselberghe System.

Fig. 6.—Diagram of the Pierre Picard System.

The Cailho system, enabling a telephonic conversation and a telegraphic transmission to be carried on simultaneously (B, B', self-induction coils, fig. 7).

When two secondary offices, S_1 and S_2, are connected with a Government office, E (fig. 1), we know that the interchange of telegraphic despatches can take place either between E and S_1, or between E and S_2, provided that the transmissions are in succession. At any moment a single transmission is possible between two of these three offices. By employing one of the systems represented above, we can use the telegraphic service under the conditions just indicated, simultaneously with a telephonic conversation between two of these three offices.

We must not lose sight of the fact that the telephonic service can only be organised in the combination that we are considering, between two offices only, and always the same two. This is due to the fact that the telegraphic calls being made by means of polarised call apparatus, the telephonic calls are made by means of phonic alternating current systems. However, if we allowed, in order to carry on a telephonic service between the three offices, E_1, S_1, and S_2, that the telegraphic calls shall be used in each office for both the telegraphic and the telephonic services, we should lose the benefit of the simultaneity of these two services, since we could not call during the exchange of telegraphic transmissions.

Moreover, assuming that there exists an appropriate system of calling, we must remark that it would be possible to superpose a telegraphic transmission and a telephonic conversation, but never two telephonic conversations. Besides the fact that out of three telephonic stations two would already be occupied with one conversation, we have not yet succeeded in realising simultaneously two telephonic conversations on the same circuit.

In short, we can arrange over a system of conductors such as shown in fig. 1, by using them suitably, for a telephonic conversation between two offices (keeping to the same two) simultaneously with the transmission of telegrams either between E and S_1, E and S_2, S_1 and S_2, the telephonic conversation being in no way impeded by the telegraphic calls and transmissions, and, in the same way, the telephonic calls and conversation can be transmitted whether the wires are being used for telegraphy or not. We propose to show by diagrams the installations that would have to be adopted in order to

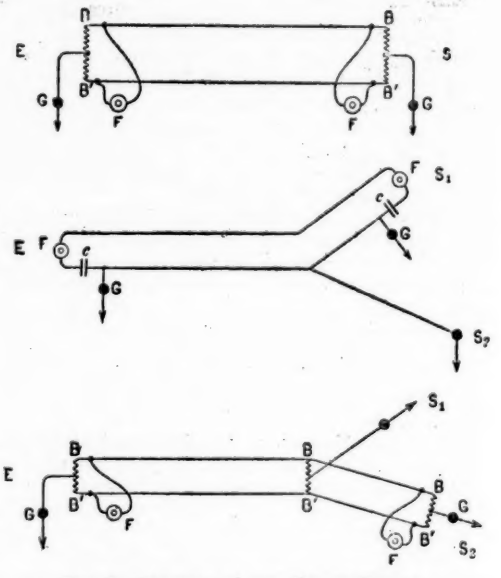


Fig. 7.—Diagram of the Cailho System.

Fig. 8—Employment of the Van Rysselberghe System between the Offices, E and S_1.

Fig. 9.—Employment of the Cailho System between E and S_2.

realise as required simultaneous telegraphy and telephony over the system of conductors connecting the offices, E, S_1 and S_2.

We will designate by the letter G the telegraph offices, and by the letter F the telephone offices.

(*f*) We may observe, first, that the Pierre Picard system seems only applicable if two offices only are on the same circuit.

(*g*) Telephonic conversation is carried on between the offices, E and S, by means of the Van Rysselberghe system (fig. 8).

(*h*) Telephonic conversation is carried on between the offices E and S_2 by means of the Cailho system (fig. 9).

(*To be continued.*)

TESTS OF LEATHER BELTING.*

By Prof. CHAS. H. BENJAMIN.

Having noticed the article by Prof. Flint, in the *American Machinist* for September 5th, on "A Study of Belt Lacings," it occurred to me that the readers of this paper might be interested in the results of some experiments recently made on the strength and elasticity of the belts themselves. These experiments were made by Mr. E. A. Drake, in the testing laboratory of the Case School of Applied Science, under the direction of the writer.

The object of the experiments was to determine the ultimate tensile strength and percentage of elongation of the best quality of oak-tanned leather belting, as made by different

* *American Machinist.*

manufacturers, and to observe the relative strength of single and double belts of the same make.

In order to obtain fair samples, the belting was all bought through outside parties in the ordinary course of trade, and the prices and discounts were practically the same for each series.

The samples obtained were the product of three of the leading belting factories of this section, and I simply will denominate them as Series 1, 2, and 3. Each series contained 10 linear feet of single belting, and the same length of double belting, all being 6 inches wide.

The belts were cut into 8 inch lengths, making 15 test pieces of each kind, and the specimens were then trimmed to the shape shown in fig. 1 to ensure breaking outside the jaws.

Parallel lines 1 inch apart were ruled across the test specimen by which to measure the elongation from time to time. The specimens were gripped at each end by corrugated interlocking jaws, and the holders containing the jaws were so pivoted in the testing machine as to insure an even pull on the two edges of the belt.

The loads were applied gradually and the elongation measured at each 500 pounds increase of load. The per cent. of elongation in two inches of length for a total load of 2,000 pounds on 500 pounds per inch of width has been placed in the tables.

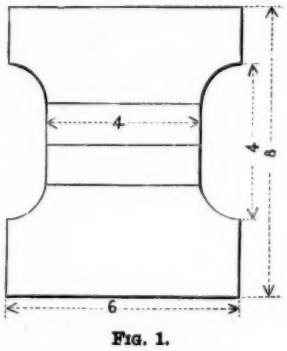


Fig. 1.

The average thickness of the single belts was about 0·20 inch, and of the double belts about 0·35 inch.

Table I.

Series No.	Single or double.	Number of samples.	Load in pounds per sq. inch.	Load per inch of width.	Per cent. elongation.
1	Single	13	4,770	905	9·88
1	Double	15	3,525	1,360	6·60
2	Single	15	5,107	1,008	7·20
2	Double	15	4,605	1,415	4·80
3	Single	14	3,730	841	10·18
3	Double	15	4,173	1,414	5·96
Average.	Single	...	4,536	918	9·09
Average.	Double	...	4,101	1,396	5·79

The average ultimate strength per inch of width for single belts, as shown by the tests, 918 pounds, is considerably larger than the value usually assigned, while the ratio of the strength of double to single belting is $\frac{1,396}{918}$, or about $\frac{10}{6·58}$, the ratio generally used being $\frac{10}{7}$. It must be remembered, however, that the belting used in the experiments was all of the first quality, so that the average strength of belting sold in the market would be less than those given above.

One of the facts most noticeable in the experiments was the greater uniformity of double belting in strength and in elasticity, due no doubt, to the fact that it is composed of two layers whose irregularities tend to neutralise each other. The single belts in nearly every instance showed a tendency to stretch more on one edge than on the other, and broke by tearing on the weaker edge, showing that edge to have been nearer the flank of the hide in the cutting. See fig 2, No. 41.

In the double belting this was less noticeable.

The strength per square inch of cross-section, as shown by Table I., is somewhat less for double belts than for single.

In every case the strongest samples showed the smallest percentage of elongation. The experiments showed conclusively the disadvantage of using rivets in making double belts. The double belts in series Nos. 1 and 3 had rivets at intervals, while those in series No. 2 were simply cemented.

In nearly every case where rivets were present the fracture commenced at a rivet hole. See fig. 2, Nos. 79, 80 and 83.

Several experiments were made on joints in single belts, and the results are given in Table II. The only cemented joint tried shows a greater strength per inch of width than any of the riveted joints.

The riveted joints show an average strength per inch of width of 622 pounds, or about two-thirds the average of the strength of the single belts tested, while the

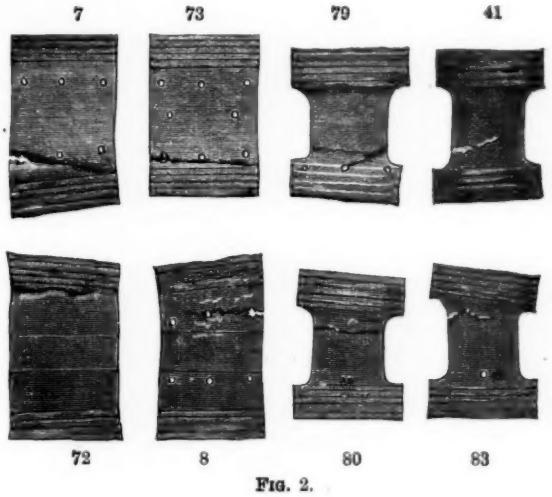


Fig. 2.

cemented joint broke at 1,112 pounds per inch of width, being a little stronger than the average of the belt samples in that series.

Table II.—Belt Joints.

Sample No.	Length of lap.	Number of rivets.	Total breaking load.	Load per sq. inch. Cross-section.	Load per inch of width.	Per cent. of elongation.
	Ins.					
7	5	6	4,170	3,940	709	7·5
8	4·6	6	3,610	3,600	611	7·5
72	7·2	9	4,520	3,545	762	5·5
73	5·1	8	2,420	1,792	406·8	7·5
44	Cemented.		4,380	5,560	1,112	7

The riveted joints always failed at rivet holes.

The principal conclusions to be drawn from these experiments are: 1st, that double belts are superior to single in respect of their greater uniformity and less liability to become crooked by reason of uneven stretching, and 2nd, that a belt can be made stronger without the use of rivets, either at joints or elsewhere, if good cement is used, and a proper degree of pressure is applied. Doubtless in situations where a belt is much exposed to dampness, rivets might be necessary at the edges of the splices to prevent starting up.

In case ordinary double belts are too heavy or too stiff for the required service, a light double belt may be obtained, which will be no heavier than a single, and much more uniform.

Several experiments were also made on some single belting of the same quality as Series No. 1, to determine the transmitting power. A 4-inch single belt, running on 24-inch pulleys, at an average speed of 868 feet per minute, developed in four trials an average of 8 horse-power with a slip of only 5 feet per minute.

The tension on the tight side was 88 pounds per inch of width, and on the slack side only 22 pounds, the coefficient of friction averaging about ·40.

The number of square feet of belt per horse-power per minute was only 44.

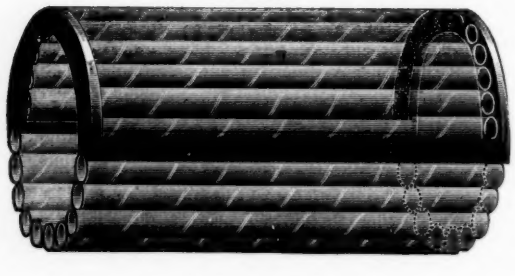
The horse-power developed is nearly double that generally allowed for 4-inch belts at such a speed, but if the belt were endless, cemented without rivets, the factor of safety would be about 10. I am inclined to believe that many of our belt formulæ are based rather on the strength of poor joints than of good leather.

HYATT ROLLER BEARINGS.

Railway managers' experience with roller bearings has been very similar to their experience with traction accumulators. Many roller bearings which in theory seem to be perfect and are satisfactory for a time in practical operation rapidly deteriorate and become unduly expensive. It is acknowledged, however, says the *Electric Railway Gazette*, that a successful roller bearing is a practical economy. The device which was produced by the Hyatt Roller Bearing Company, 133, Liberty Street, New York, some years ago has been exploited under disadvantages due to the failure of its predecessors. The company, therefore, temporarily abandoned the railway field until "time" tests on its bearings could be made. Bearings were installed on railway equipments about November, 1893, and have been running since then. Of their performance and durability the company is able to present positive statements not only of its own but of the parties who have used the bearings.

A common difficulty with rigid rollers in bearings is their tendency to get out of line with the main shaft. This not only tends to prevent their rolling free, but concentrates the stresses upon a very small area of the rollers and severely

Fig. 1.



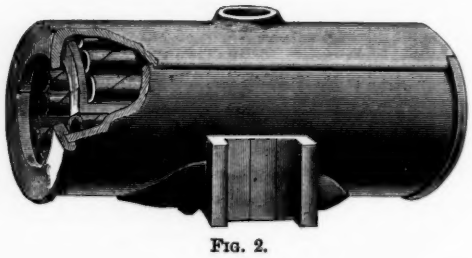


Fig. 2.

abrades them. Rigid rollers are very expensive, for they must first be hardened and then ground true. The Hyatt bearing eliminates this trouble by the elasticity of the rollers. A piece of thin, soft steel is wound about a mandrel in spiral form, as shown in the accompanying illustrations. These rollers are wound when cold, which fact alone suffices to show the excellent material of which they are made. The spiral section around its periphery enables it to give, and therefore, when there is a pressure upon it, it will touch the main shell in numerous places, even if it be considerably out of parallelism with the shaft. The roller is hollow, and therefore yields to the pressure, so that it is automatically distributed over a number of rollers, instead of being concentrated upon a few. The rollers are placed around the journal, and the cast-iron box is provided with a steel lining; a hard steel sleeve protects the axle. The tendency to get out of alignment is limited by a bronze yoke, consisting of two pieces parallel to the rollers joined together by semi-circular arcs at the end.

The utility of the roller bearing is unquestioned. Its practical success needs only to be demonstrated, and this the Hyatt Roller Bearing Company claims it is now prepared to do. When it is considered that a common brass bearing in railway work wears for only about six months before requiring to be replaced, the question of the relative initial cost of roller bearings becomes very much less important, especially as the saving in power is also very material, particularly when starting the car.

THE INSULATION OF THE RAILS OF ELECTRIC TRAMWAYS.

An elaborate series of experiments has recently been carried out by Dr. St. Lindeck, at the Reichsanstalt, Berlin, on the insulating properties of concrete and asphalte concrete.* It has been found that the electrical resistance of cement blocks, and blocks made of cement and sand or gravel, when in an air-dry condition, is relatively small; it is lowest of all in the case of pure cement, and becomes higher as the proportion of sand or gravel is increased. The porosity of the material, however, increases in the same proportion, as can be seen by the decrease in the resistance after the blocks have been put under water for some time. The resistances of cement blocks, after being under water for one day, fall to one-third of the resistance shown when in an air-dry condition. In blocks containing one part of cement and three parts sand, a two hours immersion is sufficient to bring the resistance down to one-tenth of the original; and in two kinds of concrete the resistance of the blocks, when moist, drops to about one-twentieth.

The case, however, was quite different with asphalte concrete. This material has already been used to some extent for building purposes. The asphalte concrete consists of 50 per cent. of stone clippings, 20 per cent. of rough gravel, free from loam and sand, 12 per cent. of asphaltic mastic, 8 per cent. of pitch, and 10 per cent. of German tar. The resistance of this material was found to be extremely high. For instance, a block made with syenite chippings gave in a dry condition per dm. cube 280,000 megohms. The block was then placed under water for two hours, and after having been again in air for 2½ hours, it still showed a resistance of 160,000 megohms. Even after the block had been continually under water for six weeks, it still gave an insulation resistance of 17,000 megohms.

It has been suggested by Prof. Ulbricht that this asphalte concrete should be used to insulate the rails of electric street railways, and thereby prevent those leakage currents to the earth which have been the cause of so much trouble to pipe systems and other underground conductors in towns. The experiments of Dr. Lindeck show that the insulation resistance of even a thin layer of this material is amply sufficient to stand the highest P.Ds. that are likely to occur between the rails and the ground. The only questions that remain to be considered are the durability and cost as compared with the system of feeders at present in use, and the effect of the insulating of the rails upon men and horses, which may happen to form temporary short circuits between them and the ground.

Dr. Lindeck proposes to lay under the rails a thin layer of the asphalte concrete over a bed of the ordinary concrete; but when we consider that the tie rods between the rails must also be insulated, it is evident that complete insulation of the rails can only be obtained by covering the whole breadth of the track with a layer of the asphalte concrete. It is probable that the cost of this would be prohibitive, except in a few special cases; it is not likely to be less than that of the few insulated cables required to keep the leakage currents within safe limits. The question of durability is one that would have to be settled by practical tests. When used as a building material, the asphalte concrete has merely a static load, but if used under the tramline the load would be dynamic, and would demand a considerable amount of elasticity as well as strength in the material.

Granting, however, that practice might show that the asphalte-concrete can be both economically and safely applied as an insulator of the rails of electric tramways, it remains

* *Elek. Zeitschrift*, March 19th.

to be considered what P.Ds. are likely to arise between the rails and the earth, and the effect that these are likely to have on the man and the horse on the street.

To enable an estimate of the probable amount of this P.D. to be formed, we give the following calculation, for which we are indebted to the *Elektrotechnische Zeitschrift*. The resistance of rails of 29·3 lbs. per foot run has been found to be 0·0525 ohm per mile. The resistance of rail bonds has been found to vary between 0·0232 and 0·0528 ohm per mile; the smaller resistance is found with very large currents, and the larger with small currents. If we assume 0·045 ohm as a mean value for the large currents which occur in practice, the resistance of 1 mile of rail (including bonds) will be 0·0975 ohm, or in round numbers, 0·05 ohm per mile of track. Let us now take as an example a track 7 miles in length, with the power station at the centre, then the rail current in each track has to overcome a resistance of 0·18 ohm. With a three minutes' service and a speed of 7 miles per hour, there will be 10 cars on each 3½ miles of track, each of which deliver on an average to the rails 12 amperes when running, and 40 to 45 amperes when starting. It is not improbable that four cars may start simultaneously, and in such a case the total current in the rails near the power station will be 240 amperes, and at the end of the track about 40 amperes. Under these circumstances the fall of potential between the middle and end of the track will amount to about 25 volts. If the rails are everywhere equally well insulated from the earth, the rail potential near the station will be 12½ volts under the earth potential, and at the end of the track 12½ volts above the earth potential. This is the most favourable case; in certain circumstances the whole 25 volts of D.P. may exist between some parts of the track and the ground. With longer tracks than seven miles, this D.P. would, of course, be proportionally greater.

It is difficult to estimate exactly the effect on men and horses of an E.M.F. of 25 volts, which would act between feet treading simultaneously on the track and the ground. It may safely be said that the shock would not be fatal, but it might cause a disagreeable nervous shock to persons crossing the street, and might lead to very disagreeable consequences with horses, through causing them to shy and run away.

Many of these questions would have to be decided by careful experiment before this new system of insulating rails of electric street railways can be looked upon as practicable, or superior to the present system of feeders. The vagabond currents can now be reduced to very small dimensions, and the rail kept approximately at the earth's potential throughout by a limited number of insulated feeders, in which a few volts of additional E.M.F. is inserted, to suck the electricity from the rails. Small leakage currents, of course, still traverse the earth between the junction points of the feeders, but their effect would only be felt after the lapse of a great length of time. The system suggested by Dr. Lindeck does not appear *prima facie* to be superior, except as regards some minor points, to the best of the plans at present in use. His experiments, however, are of the greatest importance, if for no other reason than that they have shown that in asphalte-concrete we possess a remarkably good insulator, which is cheap, strong, and capable of standing exposure to the weather.

SIXTY-EIGHT OCTAVES.

By T. H. MURAS.

The annexed table is intended to show, on a uniform scale, the relations of the different kinds of vibration now known. In the first column rates of vibration are given, each double that next below it, so that the lines represent successive octaves. In the upper part of this column the rates are numbers of complete vibrations per second; in the lower part rates less than one per second are given as seconds per complete vibration. In the second column the octaves are numbered relatively to one complete vibration a second. The third column gives data of vibrations that have been observed with rates approximating to those tabulated in the first column.

Table Showing Vibration Rates of Periodic Phenomena.

Complete vibrations per second.	Octaves.	Observations.
9,007,199,254,740,992	53	
4,503,599,627,370,496	52	
2,251,799,813,685,248	51	Ultra-violet photographic limit in vacuum 3×10^{15} per sec. (Schumann).
1,125,899,906,842,624	50	Photographic limit of solar spectrum $1{\cdot}053 \times 10^{15}$ per sec. (Cornu).
562,949,953,421,312	49	Green light, near Thallium line.
281,474,976,710,656	48	Infra-red photographic limit (Abney).
140,737,488,355,328	47	
70,368,744,177,664	46	Heat rays of solar spectrum, lowest measured directly (Langley).
35,184,372,088,832	45	
17,592,186,044,416	44	Heat rays from substances below 100° C.; lowest observed (Langley).
8,796,093,022,208	43	
4,398,046,511,104	42	
2,199,023,255,552	41	
1,099,511,627,776	40	
549,755,813,888	39	
274,877,906,944	38	(Eleven octaves unobserved.)
137,438,953,472	37	
68,719,476,736	36	
34,359,738,368	35	
17,179,869,184	34	
8,589,934,592	33	Electric oscillations in small spheres, (Righi).
4,294,967,296	32	
2,147,483,648	31	
1,073,741,824	30	
536,870,912	29	
268,435,456	28	
134,217,728	27	
67,108,864	26	Electric oscillations in Hertz resonator, 70 cm. diameter.
33,554,432	25	
16,777,216	24	
8,388,608	23	Electric oscillations for flying bullet photographs (Boys).
4,194,304	22	
2,097,152	21	
1,048,576	20	
524,288	19	
262,144	18	Electric oscillations in Leyden battery circuit (Feddersen).
131,072	17	
65,536	16	
32,768	15	Audible vibrations, extreme upper limit.
16,384	14	Electric alternator and turbine (Ewing).
8,192	13	Electric oscillations in Leyden battery circuit (Feddersen).
4,096	12	Music, highest note.
2,048	11	
1,024	10	
512	9	Electric oscillations in Leyden battery circuit (Lodge).
256	8	
128	7	
64	6	
32	5	Music, lowest note.
16	4	Water surface waves of minimum velocity.
8	3	
4	2	
2	1	
1	F	
Seconds per complete vibration.		
2	1	Pendulum beating seconds.
4	2	
8	3	
16	4	
32	5	Air pulsations in wind, Washington, U.S.A. (Langley).
64	6	
128	7	
256	8	
512	9	
1,024	10	
2,048	11	
4,096	12	
8,192	13	
16,384	14	
32,768	15	
65,536	16	Mean solar day, 86,400 seconds.
131,072	17	

It will be seen that 68 octaves cover the whole range of periodic phenomena from extreme ultra-violet light to the daily meridian passage of the sun. The table might, however, be extended downward to include the slower periodic phenomena of astronomy. Nearest the unit rate is the pendulum beating seconds. At some distance above this we have sound vibrations, extending over about 10 octaves, of which about seven are used in music. These overlap the rates of oscillation of electric charges in bodies of ordinary dimensions, which have been observed through no less than 24 octaves. It is important to note that such oscillations have been obtained only intermittently; practically only one complete oscillation is produced by each impulse, at the highest rates, and the impulses are comparatively infrequent. The highest rates obtained continuously have been from Prof. Ewing's 140-pole alternator and a Parsons steam turbine, and by Tesla, who appears to work usually at about 10,000 ~ a second. Above the range of electric oscillations there is a gap of 11 octaves where nothing at all has been observed. Heat and light vibrations then succeed, only one octave being visible to the eye, from about $3\cdot9 \times 10^{14}$ to $7\cdot8 \times 10^{14}$ vibrations per second. No vibrations are known having higher frequencies than those in the table, unless the Röntgen rays prove to be such.

THE CONVERSION OF HEAT INTO ELECTRICAL ENERGY.

The production of electricity directly from heat is a problem which has occupied the attention of many able electricians. Could the enormous energy latent in coal and solar heat be made to appear as electric energy, by means of a simple transforming apparatus, more efficient and less cumbrous than steam or gas engines driving dynamos, there is no doubt that great progress might be accomplished thereby, and that one of those grand steps of progress would be taken of which the 19th century so justly boasts.

Unfortunately, it seems that there is no economical solution to the problem. Three-quarters of a century have nearly elapsed since Seebeck discovered that by heating one of the junctions of a metallic circuit, consisting of two metals soldered together, an electric current was produced. The science of thermo-electricity thus originated has been developed by Becquerel, Pouillet, Peltier, Mathiessen and Thomson, but these distinguished scientists and experimenters have never succeeded in producing an apparatus by means of which more than 2 per cent. of the heat energy could be converted into electricity.

Experiments have been made in another direction. Electricity has been obtained from heat by heating and cooling magnetic circuits in rapid succession, so as to modify their magnetic reluctance, thereby inducing alternating currents in coils surrounding such circuits. Thomson, Berliner, Edison, Tesla have devoted some time to this mode of conversion, and although such ingenious apparatus as the pyro or thermo-magnetic generator have been the outcome of their work, as far as we know the efficiency obtained by this mode of conversion has never been superior, if equal, to the efficiency of the thermopile.

Can these persistent failures be attributed to the fact that such distinguished experimenters and scientists have not as yet struck the right process of conversion, or must we come to the conclusion that, after all, the most economical solution to the problem lies in the construction of a more perfect heat engine driving the already highly efficient dynamo? In a recent paper on the above subject, read before the Engineer's Society of Western Pensylvania, Leon le Pontois expresses his opinion in favour of the latter mode of conversion, and endeavours to state a few of the reasons on which his belief is based. He considers first the case of the thermo-electric battery. Thermo-electric currents have long been attributed to an electromotive force produced by the contact of heterogeneous substances, a force which varies with the temperature. Becquerel ascribes them to the unequal propagation of heat in the different parts of the circuit. He found that when all parts of a circuit are homogeneous no current is produced on heating, because the heat is equally propagated in all directions. This hypothesis has been confirmed by many experiments, showing that thermo-electric currents can be obtained in a monometallic circuit when a source of heat is applied between two neighbouring points of the circuit under different atomic structure.

He then proceeds to show how the unsymmetrical propagation of heat waves along a metallic circuit is attended by the manifestation of electric force, and refers to the Thomson and Peltier effects, the latter of which is a consequence of the former, and both are well known to the most elementary students of electricity. He points out that there is a close relation between electricity and heat; and, indeed, Hertz's experiments have demonstrated beyond doubt that light, heat, and electricity, which have their origin in a vibratory motion of matter, are propagated by ether at an equal rate of speed. Moreover, Hertz has shown that an electrical disturbance, so improperly called "electric current," is not all propagated in the wire itself, but under all circumstances penetrates from without into the wire, and spreads into the metal with a comparative slowness. Now the electric force makes itself manifest by heating effects in the conductor, but more especially by a state of stress exerted in the medium surrounding the conductor, which stress is characterised by the magnetic properties exhibited by the medium.

The formation of this field of magnetic force is progressive and is attended, while it takes place, with radiation of electric waves throughout the medium. Now, if the formation of magnetic whirls around the conductor characterises these long ether waves known as electric waves, why should not the propagation of these shorter ether waves, called heat waves, along a conductor, be also attended with the formation of magnetic fields of force in the surrounding medium?

It seems pretty well established that the only difference existing between electric waves and light waves is solely a question of wave length. Both are electro-magnetic disturbances. Why not, says Le Pontois, extend this appellation to heat waves, which are much more likely to present the same characteristics as electric waves by reason of their wave length being much longer than the wave length of light waves? It is very likely that these three apparently different forms of energy—light, heat, electricity—are endowed with the same capacity of exhibiting effects which we attribute exclusively to electricity. The only reason why they do not apparently possess the same electric capacity must be attributed to the fact that the bodies which we consider as conductors of electrical energy (because they prevent it being dissipated) present great resistance to the propagation of the rapid vibration characterising heat, and an almost insuperable resistance to the more rapid vibration, causing on our retina the sensation of light.

A variety of notions has been entertained by physicists as to the origin of thermo-electric currents. They generally have been attributed to an electromotive force produced by the contact of heterogeneous substances, a force which varies with the temperature. Lodge succeeded in a certain measure in demonstrating the probability of this hypothesis—in the particular case of a copper iron couple heated at some temperature below 275° C. But the same hypothesis is not verified in many other combinations. Becquerel ascribed them to the unequal propagation of heat in the different parts of a circuit. He found that when all parts of a circuit are homogeneous, no current is produced on heating, because the heat is unequally propagated in all directions. But, if uniformity of this is destroyed by coiling it in a spiral, or by knotting it, thermo-electric currents result from the unequal propagation of heat on both sides of the heated place. Le Pontois has made experiments which seem to demonstrate that Becquerel's hypothesis is based on facts. The unequal propagation of heat in a metallic circuit may be caused by differences in thermal conductivity—by unequal decrease of temperature on both sides of the heated place. It may also be caused by differences in the specific heat of the two metals, or at two neighbouring parts of the same metal, but whatever is the reason on account of which heat is unsymmetrically propagated on both sides of a heated point, it seems that the explanation of the phenomenon could be found in analysing carefully these different causes. He pictures to himself what is going on inside a thermopile as follows:—The propagation of heat waves on both sides of the heated point is always attended with electrical displace-

ments in the surrounding medium which affect more or less the inside of the conductor. If the circuit is homogeneous, the resultant of the electric force inside the conductor is zero, but if such is not the case, the resultant is something different from zero, and an unidirectional electrical disturbance or current takes place inside the conductor. Now, it is obvious that the dissipation of a certain amount of heat energy in a thermopile must be attributed to a loss by radiation or convection, and to the absorption of heat energy in the atomic motions which determine the manifestation of electrical energy. Hence the thermopile may be considered as an imperfect heat engine working between two temperatures. The rest of the paper is entirely of a mathematical nature. *Inter alia* he compares the efficiency obtained by the direct method of conversion through a thermopile, and that obtained by driving a dynamo by means of a gas engine, and find that the thermo-electric battery to produce an equal quantity of available electric energy, expends nearly 18 times as much heat energy as the gas engines directly driving the dynamo.

A NEW FRENCH TRANS-ATLANTIC CABLE.

(*Concluded from page* 462.)

The importance of this undertaking, and the advantages which should accrue to the State from it, must be obvious, and the explanatory statement comments as follows:—"The provision made in paragraph 1 aforenamed will enable us: To utilise a communication, sure and rapid, which will assure hereafter the regular permanence of the exchanges, by a French route; to transit by national lines a traffic which, in consequence of the insufficiency and of the insecurity of our present means, is dispersed to-day over the foreign lines; and, above all, to maintain a telegraphic circulation which France owes to the exceptional geographical position of its territory, and which it is of first importance not to weaken.

"The obligation inserted in paragraph 2 arranges for the maintaining in working order, pending the duration of the contract which is submitted to you, of the only actual existing communication. This has an exceptional value, because it guarantees the continuity of exploitation of a cable which is now probably near the end of its life, and which no clause of the original landing concession obliges the company either to maintain in working order or to renew. The stipulation enacted in paragraph 3 presents the advantage: On one hand of assuring, by exclusively national lines, the relations between the metropolis and its West Indian and Guiana colonies; on the other hand, of creating, to the sole profit of our trans-Atlantic cables, a new affluent which may bring to them the traffic from all countries served by the French company's system of which foreign companies have, to-day, the monopoly."

Art. 2.—We have spoken of this already. It stipulates a duration of 30 years for the Convention and sets aside all monopoly.

Art. 3.—Fixes the time in which the new lines should be open to the public service (two years).

Art. 4.—The object of this article, of which we have already spoken, is to assure to French industry the manufacture and laying of the cables as well as their maintenance.

Art. 5.—We have previously analysed this article.

(Headquarters in France, French directors; necessary preliminary authorisation from the Government, expressed and given in writing, whether for the cession of rights resulting from the Convention, or for the laying of other cables, which might reduce the traffic on the lines herein named.)

Art. 6.—This article treats of the subsidy granted to the company. The explanatory statement comments on this particular point of the contract as follows:—"The establishment of the trans-Atlantic cable from Brest to Cape Cod, which is the only one of the operations projected by the company with which the State has to occupy itself from the financial point of view, will entail an expense which is estimated at £800,000. The annual charge on this capital, the expense of maintenance and working of the new cable, as well as of the existing cable, of which the maintaining in working order is arranged for in the contract (the renewal being at the cost of the company), represent an annual charge of £98,000. On the other side, the receipts already acquired amount to £66,000. It appeared to us, under these conditions, that the quota of the subsidy should be represented by the difference between these two figures, £32,000. This subsidy would be mitigated beyond the total of the products already realised, £66,000, by a first deduction, to the profit of the State, of two-thirds of the receipts realised on the company's two trans-Atlantic cables; the subsidy would be entirely suspended when the amount passes beyond £114,000.

"You will remark that in virtue of this arrangement, one-third of the receipts is assigned to the company during the time that the State may yet, at least theoretically, have to continue a part of the payment. It appears to us that it would be convenient, in the interests of the Treasury, to bring about, by an immediate encouragement, the association of the efforts of the company to those of the administration, in order to cause to cease completely, and in the shortest time possible, the payment of the subsidy. The participation admitted, to the profit of the concessionaires, in the receipts realised beyond the minimum named, will permit of the attainment of this object. It remains to be, gentlemen, and this is the question which may justly solicit your attention, under what limit this subsidy should really be carried out. From the very first it is a reassuring fact that under the least favourable conditions the subsidy can never be paid in its entirety. The minimum of £66,000 product, below which the integral payment would be made by the State, is already, as we have indicated, attained by the accumulated receipts of the company's actual cable, which figures reach £38,000, and by the amount of the value of the telegrams which the Administration will forward to the company in compliance with the dispositions of the Article 9 of the Convention. If one takes into account, besides, that the company undertakes to forward by the subsidised lines all traffic which shall be collected, subject only to the observation of the rules of the telegraphic union; that the new part of this traffic, which the advantages of rapidity and economy of the connecting line will draw to the French North Atlantic cable, may be valued, under the most prudent estimate, at £9,600; that the French transit will increase considerably in consequence of the incontestable superiority of the new outlet, which will be opened to it; finally, that the company will be able to acquire a certain return circulation, one can, without fear, look forward to the near approach of the time when the Treasury will not have to make any appreciable payment, owing to the receipts proper of the enterprise, as well as to the increase of traffic, and consequent profit to be derived from the corresponding supplementary product. The Commission has approved the article as drawn up."

Art. 7.—Here the Commission proposed to modify the text which was presented to it. According to this text the State imposed on the company a reduction on its receipts, to commence from the day when the subsidy shall cease to be paid, of a sum of 50 per cent., to be applied to the formation of a reserve fund. This fund, which has a specified object, and which will be placed under the control of the Government must serve to provide for unforeseen losses, which might have the effect of bringing again into force the payment of the subsidy, either integrally or in part, and also to the laying of new cables, amongst others that are named in Article 9. But it appeared to the Commission that the reserve fund ought not to be set aside for the establishment of the cable named in Article 9. When the necessity arises, this establishment is one of the charges which the contract imposes upon the company by Articles 1 and 9; it is only voluntary, and in case of necessity, the State has always the right to control the funds. Then, and this is the essential point, the Commission thought that a provision should be made, before all things, as the best manner of employing the excess not assigned to the company, for this repayment to the State of the sums which shall have been paid under the title of subsidy. These views have been adopted by the Government, and accepted by the company, and they have been inserted in the supplementary agreement attached to the contract.

Art. 8.—No objections have been raised to this article; it authorises the company to issue shares, which shall be guaranteed by the subsidy or by the receipts, when the former is no longer in force. It establishes, moreover, a control

over the company's accounts, which will be exercised by the Minister of Finance.

Art. 9.—This article treats of the route of telegrams, and direction of the traffic. It provides, moreover, for the time when the State shall be able to compel the laying of the new cable in the place of the actual cable, Brest-St. Pierre-Cape Cod, which must from to-day be exploited and maintained in working order until its renewal.

Art. 10.—This article regulates the conditions of tax, and the reductions which will be made on State telegrams emanating from French agents.

Art. 11.—Refers to the security, which was put at 400,000 francs, and which must be totally repaid after the new trans-Atlantic cable shall have been opened to the public service. The Budget Commission requested that this security might be increased to 500,000 francs, and that only three-fifths of this sum should be returned after the new cable shall have been opened to service; the remaining two-fifths would be held as a supplementary guarantee to those provided by Article 13, for the execution of the contract of exploitation.

Art. 12.—Fixes the delay indemnities.

Art. 13.—Treats of penalties and forfeits the company would be liable to in case of interruption of the service, non-justified.

Art. 14.—Carries no other observations than those already presented above; it is conceived thus: "The Government reserves the right to organise such control as it may judge advisable, in order to insure the execution of the present contract."

Art. 15.—This article refers to the conditions of contract. The Commission desired that it should be well understood that this document, to which is attributed the same value as the convention which is submitted to us, cannot, in any shape or on any point, alter the terms of the convention, or modify the spirit or the letter of any of its articles. Following these indications, the last phrase of this article has been expressed in the supplementary agreement.

Art. 17.—This article refers to the case where the Minister shall be able to declare the annulment of the contract. The Commission asked that the paragraph 3 of this article be added to, and that not only the articles 4, 5 and 9, but also articles 8 and 13 be mentioned as constituting clauses of which the non-observation would entail the annulment of the Convention.

This is the last modification in compliance with the wishes of the Budget Commission, which is inserted in the supplementary agreement.

Art. 18.—This article states that all disputes which may arise between the Government and the French Cable Company in reference to the application of the Convention, or of the conditions of contract, will be decided by the Council of State. After having successively examined the Articles of the Convention, it only remains for us to recall the consideration which influenced the Government in drawing up the explanatory statement.

"To sum up then, gentlemen, the assistance which we ask for the Treasury, in order to aid the company in the work which it is about to undertake, is certainly more necessary as a mark of encouragement than as an effective subsidy. Careful study demonstrates this fact, and one sees it by the charges assumed by those interested who share our confidence in the future happy financial result of the work. The patronage of the State is, however, at the present time indispensable; it is, above all, necessary, in order to give to the new cable industry in our country the means to develop, and to put it in a position to be able to lend to the Government the material collaboration of which it stands in need, in order to put in force those resources of which it disposes, and of which, in default of the company, it would not be able to turn to the profit of the national interest.

"Leaving aside all other considerations, the amount of the subsidy is very small, considering the great interests at stake. The State obtains the laying of a new trans-Atlantic cable valued at £800,000, the eventual renewal of the existing cable, which is estimated to cost approximately £400,000, and finally the establishment of a connecting line between our trans-Atlantic lines and the French lines of the West Indian system, estimated at £240,000.

"In presenting to you, gentlemen, the project of which we have sketched the main lines, we are convinced that every care has been taken to guard the interests of the Treasury. Permit us to say, however, that the question is not deserving of examination from this point of view only.

"The work which the Government is endeavouring to carry out is, for various reasons, a work necessary to the country, and we are confident that you will examine it with the same solicitude as you have always shown towards everything that touches the country's welfare."

On the strength of the considerations set forth in the present report, I have the honour, in the name of the Budget Commission, to propose to the Chamber the adoption of the Act of which the following is the tenor:—

ACT.

Sole Article.—Approved.

1. The Convention attached to the present Act, concluded July 2nd, 1895, between the Minister of Commerce, Industry, and Posts and Telegraphs, and the French Telegraph Cable Company, for the establishment, maintenance and exploitation, during 30 years, of submarine telegraph cables between France, North America and the West Indies.

2. The Supplementary Agreement, signed December 19th and 20th, 1895, to this Convention of July 2nd, 1895, attached to the present Act.

This Convention and this Supplementary Agreement will be registered under the fee fixed at 3 francs.

THE RÖNTGEN RADIATION.

SINCE our last issue, accounts of some very interesting work on the X rays have come to hand. Tesla communicates to the *Electrical Review*, N.Y., a description of his recent work, which is concerned principally with the reflection of the X rays. He fixed plates of two metals to be compared on a thick sheet of lead, and used this as a reflector to throw the radiation from each metal separately on a photographic plate. By means of the density of the impression obtained on developing, he was able to compare the reflecting power of the different metals tested. Iron and copper compared in this way were found to be practically equivalent; so also tin and lead, the tin being found to be merely a trifle better; magnesium was found to be a little better than zinc.

Tesla has utilised this reflecting power of metals to increase the efficiency of his X ray tube. He places his tube inside a funnel-shaped reflector of zinc, 2 feet in length, having a diameter of 23 inches at one end, and 5 inches at the other end. With this arrangement he has been able to take a remarkably distinct photograph of the shoulder and ribs of a man, which we here reproduce. The length of the exposure was 40 minutes, which is by no means long when we consider the thickness of the parts penetrated by rays, and the distance (4 feet) of the plate from the electrode of the tube. The chief advantage of a reflector is that it is capable of concentrating and combining the rays from a number of tubes. No doubt a more efficient reflecting material than zinc—which reflects only 3 per cent. of the radiation—will yet be found.

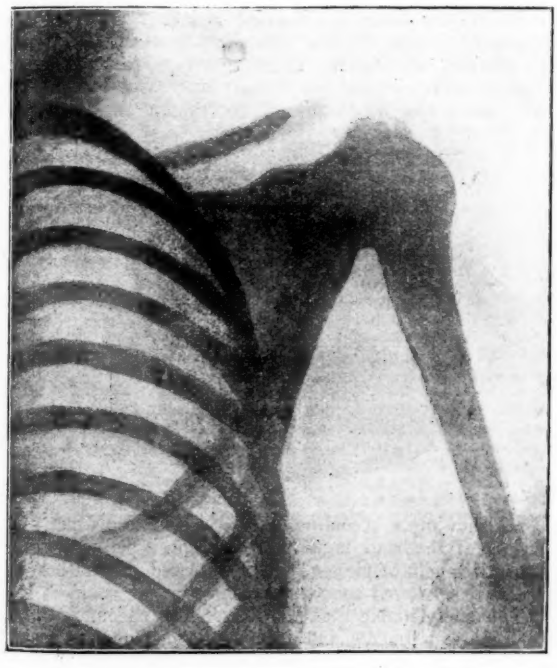
In connection with Tesla's idea of obtaining powerful beams of X rays by means of a reflector, a communication on the "Diffusive Reflection of Röntgen Rays," * presented by Prof. Pupin to the New York Academy of Sciences, will be read with the greatest interest. Prof. Pupin used a rotary interrupter, giving 60 breaks per second with his induction coil, and two adjustable Marshall condensers in shunt with the break, by adjusting which he was enabled to reduce the break-spark to a minimum. This arrangement he found to be far more effective and regular in its action than the ordinary interrupter.

The Edison tungstate of calcium fluoroscope was used by Prof. Pupin for examining the intensity of the X radiation. His experiments with his tube led to the conclusion that there was a critical temperature at which the tube gave out its maximum radiation. This, which has already been observed by Mr. Jackson and others, simply means that when the vacuum in the tube is too high, it may be readily reduced to the proper intensity by gently warming the tube by a Bunsen burner or spirit lamp.

* *Science*, Vol. iii., p. 538.

Prof. Pupin having got his tube in good working order, proceeded with his experiments on reflection. He says :—"The tube was placed between two thick planks of pine coated with sheet lead $\frac{1}{16}$th of an inch thick. This screening was found to be somewhat inefficient when the tube operated at maximum efficiency, and another screen, consisting of a thick copper plate, had to be employed. The planks were placed so as to form a wedge around the tube. The cathode streamer was horizontal, and passed through a vertical slit formed by the edges of the two screening lead-covered planks. In front of this slit was a fixed pivot on which a mirror could be rotated. The mirror consisted of a polished sheet of platinum pasted upon a rectangular piece of pineboard of nearly the same area as the platinum sheet, and about 1 inch thick. The slit was about $\frac{1}{16}$th-inch wide, and its image was examined by means of the fluoroscope. The tube was 6 inches from the slit."

"Quite near the slit the image was sharp and intense. But as the fluoroscope was gradually moved away from the slit, its image broadened out somewhat, and there was at each side of it a diffuse border. At about 2 inches from the slit, the image of the slit looked like a wide spectral line upon the less luminous background of a wide band, which shaded off gradually into the dark space of the screen. With increase of distance, the relative intensities of the two grew more and more equal, and at about 6 inches from the slit the whole fluorescent screen (about 6 inches by 4 inches) was uniformly illuminated. There was evidently a diffuse scattering of the X rays in their passage through the air. This inference was confirmed by other experiments, which will be discussed presently. Various well-known devices were employed to concentrate the cathode rays along the axis of the tube. So, for instance, wrapping tinfoil around the tube. This, however, did not diminish the gradual diffusion of the image of the slit on the fluorescent screen, when the distance between the slit and the fluoroscope was gradually increased. Up to about 3 inches from the slit, the real image of the slit could still be distinguished easily from the diffuse background as a band of maximum intensity.



"The platinum mirror was now placed quite near the slit, and at a convenient angle to the direction of the ray, and the fluoroscope was placed quite near the mirror. There was a faint illumination of the fluorescent screen, but it was perfectly uniform. Not the slightest indication of an image of the slit could be detected, although the distance between the slit and the mirror, plus the distance between the mirror and the fluorescent screen, was less than the distance at which the image of the slit on the fluorescent screen appeared as a band of maximum intensity when observed directly. A change in the angle of the mirror produced but a small change in the fluorescence of the screen, and then the change seemed to be such as to approach a maximum, when the mirror and the fluorescent screen were parallel to each other. The same experiment was repeated with other metals, and with the same result. This experiment, therefore, does not speak in favour of regular reflection.

"Turning the mirror completely around, so that the face of the wooden block on which the metal plate was fastened served as a mirror, it was found that the fluorescent effect upon the screen was stronger than with the platinum. A pad of paper of about the same size as the wooden block acted more strongly than the platinum or any other metal. Various substances were tried, like glass, vulcanite, the hand, various metals, and they all produced a diffuse reflection of varying intensity, and at all angles of inclination. In all cases the maximum effect seemed to take place when the broadest side of the reflecting object was about parallel to the fluorescent screen. But the fluorescence was very weak as long as the slit was narrow.

"The slit was now made wider, and the same series of experiments were repeated with various widths of the slit. The fluorescence of the exploring screen increases, of course, with the width of the slit. The observations made with the narrow slit were confirmed. In every case the maximum intensity on the exploring screen was obtained when the broadest side of the reflecting object was about parallel to the screen. Wood and transparent insulators produced a stronger effect than metals. No accurate quantitative comparisons have yet been made. Among the insulators experimented with, wood produced the strongest effect, and among the metals aluminium is the weakest for the same thickness of the plate. The thickness of the reflecting plate increases the effect; this increase will go on until the reflecting plate is several inches thick if this plate is an insulator. In the case of metals, however, like sheets of iron or copper, the change in the fluorescent effect due to the diffusely reflected radiance ceases as soon as the reflecting plate becomes thick enough to be practically opaque to the direct ray.

"The human body when in the path of the X rays will act as a reflector. It is quite an easy matter to detect a person walking across the room in the vicinity of the slit, for as soon as a person crosses the path of the X rays the fluoroscope will light up. While making this particular observation, I noticed that when the tube was operating especially well, a faint fluorescence was still present, even if no reflecting body was in front of the slit. Precautions were observed to exclude any radiance that might reach the fluoroscope directly by a sort of diffraction around the edges of the slit, but still the fluorescence in the fluoroscope persisted. There was evidently a diffuse scattering of the Röntgen radiance in the air itself. This, however, is so small that it is distinctly noticeable only when the tube operates so powerfully that a strong image of the hand on the fluorescent screen can be obtained by the radiance reflected from a pine board 2 inches thick and 16 inches square, placed at a distance of 6 inches from slit. With a good sized tube of proper vacuum, and working at the temperature of highest efficiency, this intensity is not at all difficult to obtain, provided, of course, that one has sufficient electric power to excite the tube."

It is, unfortunately, not clear from Dr. Pupin's description whether the paper, wood, &c., which he tested as reflectors had in every case a backing of platinum foil. If they had, a large part of the reflection produced by these substances might be due to the platinum. It is certainly surprising to find that the most transparent substances are the best reflectors.

Dr. Pupin favours the theory that "the X rays are due to a circulating motion of ether, and that the stream lines are deflected and diffusely scattered within molecular insterstices of ponderable substances." Certainly many things appear to support this view, which has already been put forward by Prof. Salvioni and others. With the object of settling this question, Salvioni constructed an apparatus for measuring the velocity of the X rays, which he showed to an interviewer as long ago as February 25th this year.* The apparatus consisted of two metal discs placed on a rod to revolve at a distance of 10 centimetres from each other. From the centre

* *Electrical Review*, N.Y., April 8th, p. 181.

to the outside edge of each there was a small triangular opening, one placed directly opposite to the other. If the discs revolve with sufficient rapidity, the rays which pass through the opening in the first disc are intercepted by the second disc. From the speed of the discs required to produce this result the velocity of propagation of the rays may be deduced. Salvioni's results, so far, are against the theory of these rays being of the same nature as light. Further experiments, however, are required to settle this important question.

Mr. Edison describes* a curious experiment which may yet be of some importance in connection with the theory of the X rays. The X ray bulb was placed on one side of a steel plate, the observer being on the opposite side. When his fluoroscope was placed against the steel plate, directly opposite the bulb on the other side, no light was observed, but when the fluoroscope was made to approach within 6 inches of the edge of the plate, but well within the shadow, it again lighted up. The direction of these X rays were found by means of an iron bar, and it was found that they were streaming round the edge of the steel plate. This looks very like stream lines getting round an obstruction, but to Mr. Edison it suggests the fantastical theory that the X rays are nothing more nor less than sound waves!

In the *Electrical Engineer*, N.Y., will be found described several experiments by Prof. Stine, Chicago, and by Scribner and M'Berty, made with a view of determining the source of the X rays. Shadows from concentric tubes have been made use of by the former, and pinhole devices by the latter. They all confirm Röntgen's original conclusion, that the direct source of the X rays is the spot where the cathode rays strike the walls of the vacuum tube. Elihu Thompson also recants his belief that the anode is the source of the X rays. Dr. Lodge describes, in a contemporary, some interesting experiments he has made to determine the source of X rays in tubes like the focus tube, where the cathode stream does not impinge on the sides of the tube, but on an interposed metal plate. He finds that the efficiency of this metal reflector, as a source of rays, is greatest when it is fixed on the anode; when connected to the cathode the radiation is practically zero.

M. Lefay† describes an experiment which appears to show that under certain circumstances the Röntgen rays, like the Lenard rays, are deflected by a magnet. Below a Crookes tube, at about ½ cm. from the most brilliant part, he placed a screen of lead perforated by an aperture of 2 mm. in width; at 0·04 metre lower, a second screen of lead, having a slit of 5 mm. in width, completely closed by leaf of silver excessively thin, supported by a platinum wire of 1·5 mm. in diameter placed exactly in the axis of the opening and opposite the silver leaf. By this arrangement the shadow of the platinum wire may be projected on a sensitive plate placed below, by a sheaf of rays determined by the two slits.

When Lefay connected the silver leaf to the negative pole of the induction coil, he found that he could deflect by a strong magnetic field the beam of rays that had passed through the silver leaf. When the silver leaf was disconnected from the coil, no deflection of the rays could be produced. This experiment appears to completely explain the different results obtained when the magnet acts on Lenard and Röntgen rays. Lefay's arrangement is practically equivalent to a Lenard tube, in which the aluminium window was connected to the cathode terminal—without this connection Lenard ought to have got non-deflectable X rays. If this deduction should be confirmed by experiment, we will be a step nearer the knowledge of the relation between the rays of Lenard and the rays of Röntgen, which have so many of their properties in common.

M. Rydberg has‡ been investigating the cause of curious mechanical action of X rays on the radiometer, which was described in the Electrical Review, Vol. 38, p. 293. He comes to the conclusion that these actions are due to attraction of the electrostatic charge produced on the end of the tube, where it is struck by the cathode rays. By surrounding the radiometer by a metallic screen, he found that the directive action of the X rays on the radiometer ceases.

MM. Blennard and Laresse§ have tested the opacity to the X rays of a large number of different solutions. He finds that the opacity is approximately proportional to the atomic weights.

Kalischer* has found that by using Lecher's arrangement for producing short, high frequency waves, he can obtain Röntgen rays from the comparatively low vacuum Geissler tube. The modification of this apparatus used by Ebert to excite his luminescent lamp ought to be equally, if not more effective, but we are not aware of it having yet been tried.

* *Electrical World*, N.Y., April 8th, p. 353.
† *Comptes Rendus*, cxxii., p. 713.
‡ *Ib.*, cxxii., p. 715.
§ *Comptes Rendus*, cxxii., p. 723.

THE EDISON FLUOROSCOPE.

The construction of the instrument, for the use of surgeons and physicians, is very simple. It consists, says the New York *Electrical World*, of a tube about 8 inches long, larger at one end than at the other. The smaller end is so arranged as to fit snugly about the forehead and eyes. The larger end is covered by a piece of cardboard, on the inner side of which is a piece of white cloth coated with tungstate of calcium crystals. A handle placed on one side enables the observer to hold the instrument. The accompanying illustration shows clearly the position of the apparatus, as is arranged in the Edison laboratory. The vacuum tube is placed in a wooden box about 8 inches square and 1½ feet in length. The hand or object that is to be examined is laid directly upon the box over the tube, and the observer puts the fluoroscope to his eyes and looks down. If Röntgen rays are being emitted from the tube, the tungstate crystals fluoresce and the observer can plainly see the shadow of, for example, the hand, the

bones and joints becoming quite clearly and distinctly outlined. If the hand is moved, the action is perfectly visible, while if a coin or piece of metal is placed on the box, this is clearly shadowed upon the screen.

The chief trouble that Mr. Edison has encountered, both in these experiments and in his previous ones, in making Röntgen pictures, has been in maintaining permanently a proper vacuum in the tube. After the apparatus has been in operation for a time varying from three hours upward, the action of the tube gives evidence of an increased vacuum, and the Röntgen effect is diminished. To obviate this hindrance to the proper and continuous running of the instrument, Mr. Edison, in the apparatus which he proposes for the medical use will include a mercurial pump; the tubes will not be sealed over, and by means of the pump this vacuum can be regulated at any time.

CORRESPONDENCE.

The Light Locomotive Bill.

The Light Locomotive Bill which was recently introduced in the House of Lords is of such vital importance to the electrical industry, that perhaps you will find space for the following:—

Mr. Chaplin received the deputation headed by Sir David Salomons on February 12th, after which I had an interview with him, and I wrote to him at length on the following day. I need not, however, trouble you with my letter of

* *Elek. Zeitschrift*, April 16th, p. 250.

that date or Mr. Chaplin's courteous answer. When, however, on March 30th we were able to obtain a copy of the Bill, I wrote to Mr. Chaplin a letter, copy of which I enclose, together with his reply. I am glad to be able to add that on Tuesday last Mr. Chaplin and Lord Harris did me the honour of receiving me at the Local Government Board. I found them most anxious to do all in their power to meet the reasonable requirements of all the industries interested in this particular Bill. They, however, are of opinion that it is essential some restriction should be placed on weight, as otherwise they fear that heavy traction engines will be run about the country and through our towns at a considerable speed. I am glad, however, to be able to add that though they were not able, until after consulting with their technical advisers, to determine the exact limit of weight that the Government may think necessary, yet I have no doubt when the Bill is read a second time in the House of Lords, we shall find instead of two tons, if not five, at any rate four tons will be substituted. Mr. Chaplin said that this is a matter of experiment, and that the Government, while most anxious to assist the industries connected therewith in every possible way, felt that until some experience was gained on the subject they must be very cautious. Electrical omnibus traffic can certainly be conducted with success with a weight of five tons, and I have very little doubt that even if we are restricted to four tons, we shall be able to do very well with this traffic in our London streets and in other towns.

S. Flood Page.

[Copy.]

102, St. George's Square, S.W.,
April 1st, 1896.

Locomotives on Highways.

Sir,—I have the honour to remind you of the interview which you accorded me, after you had received the deputation on the above subject, on February 12th, together with my letter of February 13th, and the answer of your secretary thereto. I am afraid that in the multitude of the business connected with your department you have overlooked your kind promise to bear in mind my representation as to the vital importance to the electrical industry of not limiting the weight of the omnibuses or carriages to be used in towns to 2 tons. I may state that this limit, which is unfortunately contained in the Bill, has created great consternation amongst those connected with the electrical industry. It was only the day before yesterday that we were able to obtain a copy of the Bill, and I have already received communications from several of the leading representatives of electrical work, suggesting my writing to the papers, holding meetings, &c. I have, however, such confidence in your promise as to feel assured that such public agitation will not be necessary.

If this limit is maintained, it will practically exclude the use of electricity for horseless omnibuses, though it is undoubtedly the safest, cleanest, and best for such carriages.

On Wednesday last I was speaking at the meeting of the Associated Chambers of Commerce as one of the Council of the London Chamber, and remembering your promise that you would bear in mind my representations on this subject, I stated that we might look forward to this Bill with complete confidence that there would be no restriction put on horseless omnibuses not found necessary with the existing omnibuses, and no unnecessary interference with the natural development of the electrical industry as applied to omnibuses, &c., in towns. Judging from the welcome this announcement received from the delegates of the Associated Chambers, I have no hesitation in saying that if it had entered into my mind that this prohibitory restriction of weight would have found place in the Bill, I should have been able to get a resolution passed unanimously asking you to withdraw your present limit—if, in fact, you thought it essential that there should be any limit whatever, or any restriction beyond that for street traffic in London at the present moment. You are aware that laden waggons of 16 tons are now legally permitted to traverse our streets, while the large three-horse omnibuses, weighing very many tons, are allowed the free use of the Paris streets.

This question is one of such absolutely vital importance to the electrical industry—which, as you are aware, has been most seriously hampered in this country by what is now recognised as erroneous legislation—that I do hope you will be able to remember your most kind promise to give effect to my representations, and that you will prevent the agitation which must immediately be excited if this most lamentable, unnecessary, and unjust restriction is maintained in the Bill.

Naturally I will not ask you to see me, with one or two other representatives of the industry, during the short Easter holidays, but I shall be most glad if, before any public meeting is called, you would see me, with one or two representatives of the electrical and carriage building industries, so that if possible the necessity for this agitation may be done away with.

I have the honour to remain, Sir,
Your obedient Servant,
(Signed) S. Flood Page.

To The Right. Hon. H. Chaplin, M.P., &c.

[Copy.]

Local Government Board,
Whitehall, S.W.,
April 2nd, 1896.

Dear Sir,—Mr. Chaplin desires me to reply to your letter on the subject of the Light Locomotives Bill.

The Bill has been introduced in the House of Lords, in consequence of the pressure of other business in the House of Commons.

The question of the weight of the articles to which the Bill is to apply is a matter of detail, and Mr. Chaplin is perfectly ready to receive and consider suggestions on the subject, which is a new one to all concerned, and of which there has been so little practical experience.

He has forwarded your letter to Lord Harris, who has charge of the Bill in the House of Lords, and from whom your suggestions will, he is sure, receive every attention.

When the Easter holidays are over, Mr. Chaplin will be very willing to see you, in company with Lord Harris, or to receive in writing any further statement on the subject which you may like to submit.

Yours faithfully,
(Signed) H. C. Munro.

Röntgen Rays: A Suggestion.

Mr. Jackson is reported (Electrical Review, April 10th, p. 471) to have obtained shadows on fluorescent screens, due to Röntgen rays, at 20 feet from the bulb emitting them. Tesla (Electrical Review, April 3rd, p. 437) has obtained photographs at 40 feet. These distances appear to be sufficient to allow a direct determination of the velocity of the Röntgen rays in air to be made by a modification of Fizeau's method of determining the velocity of light. As the rays cannot be reflected without great loss, and perhaps modification, it would be necessary to use two toothed wheels rotating synchronously, perhaps on one shaft, one near the bulb, and the other near the fluorescent screen or photographic plate. The necessary speed of rotation of many-toothed wheels, 20 feet apart, would not exceed that obtainable from a steam turbine. The result would probably indicate the nature of the rays. If the velocity found were that of light, the conclusion would be obvious. A lower velocity would indicate that the rays are radiant matter. A higher velocity than that of light would indicate longitudinal vibration of the ether. Check experiments, in which the rays passed near, but not between the teeth, would be necessary to show whether they were deflected by the proximity of the rapidly rotating wheels.

T. H. Muras.

[We would call the attention of our correspondent to Salvioni's experiments on p. 553.—Eds. Elec. Rev.]

Determining Insulation Resistance.

I shall be glad if you will tell me, through the correspondence columns of your paper, what is the usual method adopted in an ordinary three-wire station for determining the insulation resistance of the mains, *without interrupting the supply of current*. Can an ordinary P.O. bridge be used?

A diagram and arithmetical example would be much appreciated, and I am sure would be useful to others, besides myself.

Ajax.

[It is not usual to employ any means to determine the insulation resistance of the mains of a three-wire system, without interrupting the supply of current. An ordinary Wheatstone bridge would be useless for the purpose, inasmuch as the principle of the bridge requires the resistance to be tested to be free from an electromotive force, and, in any case, to ascertain the resistance between mains and earth necessitates the disconnection of the dynamos and batteries from the distribution network. Professors Ayrton and Perry and Dr. Hopkinson have devised means of measuring the insulation resistance of mains while the current is on. Lord Kelvin has also described a test that can be taken with an electrostatic voltmeter on high-tension supply cables with the same object. Major Cardew has also worked out this subject. Mr. Bromley Holmes uses a recording voltmeter to give the P.D. between the best insulated of his two mains at Liverpool and earth, and ascertains the insulation of the other one by earthing the former through an ammeter at intervals. A description of this was given in our account of the Liverpool supply some years ago. With three-wire systems operating at 220 volts between each outer wire and the neutral wire, the Board of Trade allow the latter to be

connected with earth, and this in itself prevents one testing the insulation with the current on. The usual station routine is to take current off at the station once a week or at any other desired interval, and to test with a bridge the insulation of the distributing network. Each section of the mains on a modern station can be disconnected by means of street boxes from its neighbours, and when so isolated the bridge test can be applied.—Eds. Elec. Rev.]

Recording the Output of Central Stations.

I should be extremely obliged if you could, through the medium of your valuable paper, inform me what is the method employed in central stations for obtaining the unit output, where three or more dynamos are working, and the amperes, volts, and hours vary as shown on enclosed sheet?

Megohm.

[The current from each dynamo would usually pass through a form of station bus bar, and on this there would be a recording or registering ammeter which would record both current and time, so that when an additional machine was switched into the feeders through the bus bars, the recording ammeter would register more current, and the stopping of any machine would effect it in the reverse way. The voltage is kept constant by regulation, and would not, as a rule, be actually registered. No doubt our correspondent has knowledge of the various forms of registering meters. Those most commonly employed in English central stations are Holden's, Nalder's, and Richard Freres.—Eds. Elec. Rev.]

Safe v. Dangerous Electric Light Currents.

As I have always from practical experience contended that electric light and power can be more efficiently and economically supplied to towns and urban districts within a radius of five or six miles by using continuous currents than high pressure alternating currents, I was, to settle as far as possible the question of danger, impelled to write to the Board of Trade for information.

To my letter of inquiry they have courteously replied as follows:—

"In reply to your letter of the 9th inst., I am directed by the Board of Trade to state that they have been informed of nine cases of fatal accidents to employés at generating or transforming stations where high pressure alternating currents are used, but that no instances have been reported in the case of low pressure continuous currents."

As the information received is of great public interest, I trust you will see the desirability of making this known to your numerous readers.

A. L. Fyfe.

April 20th, 1896.

To "Recorder."—We last heard of Sir Thomas Salter Pyne about a fortnight ago when he was in the neighbourhood of Coventry purchasing cycles for the Ameer of Afghanistan. You would probably be able to ascertain his present whereabouts by applying at the India Office, Whitehall, London.—Eds. Elec. Rev.

LEGAL.

Dewhurst & Russell *v.* Scriven.

This case, which came before Mr. Verey in the Official Referee's Court, on March 12th and 18th, was a claim by the plaintiffs for wiring and fitting defendant's premises at Leonard's Place and High Street, Kensington, for electric lighting. Plaintiffs held that the charges were fair and reasonable, and produced evidence to that effect. The price quoted verbally for fitting up complete was 25s. per 16-C.P. lamp, and 28s. per 32-C.P. lamp. Mr. T. E. Gatehouse, called on plaintiffs' behalf, said that he had examined the work, which he found well done, best quality material having been used. He considered 25s. per 16-C.P. lamp a fair and reasonable charge for the work in question. The prices of leading wiring firms for similar work would probably be higher, certainly not less than that figure. Mr. T. W. Biggs, surveyor, also gave evidence to the good quality of the work and the reasonableness of the charge. Plaintiffs called several other witnesses who gave evidence to the same effect.

The defence set up was a denial that the work was done at defendant's request, that the prices charged for the work, materials, &c., were not fair and reasonable, that plaintiff verbally offered to do the work at 15s. per lamp instead of 28s. as charged. It was also stated that the amount due to plaintiffs at the commencement of the action was £25 4s. 7d., for which sum a cheque was tendered but refused, and which sum defendant paid into court with an additional £5, which was considered sufficient to satisfy plaintiffs' claim. In support of this defence, Mr. Hussey, a builder and undertaker, was called and said he had carried out work at 15s. per light; Mr. Allright, of the House-to-House Electric Light Company, Limited; and Mr. Gilbert (who had also done work at 15s. per lamp and afterwards regretted it).

On March 19th, Mr. Verey gave judgment for the plaintiffs for their full claim of £57 17s. and costs.

Swinburne & Co. *v.* Andrews & Co.

On Monday, in the Westminster County Court, this case came before His Honor Judge Lumley Smith, Q.C., and was a claim for £59.

Dr. Hebbert Smith was counsel for the plaintiff company, and said the action was one remitted from the High Court, and there were only two items in dispute. The claim was for goods sold and delivered, and the two disputed items were about an alternator and alterations to arc lamps. There was a contract to supply the alternator in October, 1894. It was erected in pursuance of the agreement at the premises of Mr. Brown, a builder at Balham.

After evidence had been given on both sides, His Honor delivered judgment for the plaintiffs for £45. The defendants had paid £8 into court.

Actions Against the Central London Railway Company.

At the Guildhall (Westminster), last week, before Mr. Troutbeck, the Deputy High Bailiff of Westminster, and a jury, Mrs. Winckworth claimed from the Central London Railway Company £10,435 as compensation for the freehold interest in the premises, 237, Oxford Street, required by the company for their Oxford Circus station. The amount of the claim was based as follows:—The value of the leasehold interest, which had 16 years to run, at £300 per annum on the 4 per cent. table, £3,525; the value of the reversion after 16 years was £450—the premises being let at present much under their real value, which, on the 4 per cent. table, was £5,962, making, with 10 per cent. for compulsory sale, £10,435. For the company Mr. Watney, President of the Institute of Surveyors, and Mr. Garrard were called as witnesses, and put the full value of the premises at £6,600, plus 10 per cent. for compulsory sale. The jury assessed the damages at £9,900.

The hearing was resumed on Saturday last at the London Sheriff's Court, Red Lion Square, Holborn, before Mr. Under-Sheriff Burchell and a special jury, of the case of the Kensington Woodhouse Park Syndicate, Limited, *v.* the Central London Railway. This was the third day of the hearing. It was an action in which the claimants, who are the present holders of an estate in Shepherd's Bush, known as Woodhouse Park, sought to recover from the Central London Railway Company the sum of £32,790 for the compulsory acquisition of their interest in the property. The land in question, which extends to 10 acres, has been scheduled by the railway company in connection with their proposed line between Shepherd's Bush and the City, for the purpose of the construction of a generating and terminal station. The claimants contend that the property is valuable to them either for exhibition purposes or for building operations. This the respondents deny, pointing to the fact that no exhibitions in this part of London have yet been remunerative. They also claim that no building could be carried out until the present vested interests in the property were bought in, and that for these reasons the marketable value of the claimants' interest was very small. Evidence having been given the hearing was adjourned until next Saturday.

Sequel to a Main Box Explosion.

In the Queen's Bench Court on 17th inst., before Mr. Justice Cave and a Common Jury, Mrs. Holdsworth, the wife of a plasterer, sued the Vestry of St. Pancras to recover damages for personal injuries sustained through the alleged negligence of the defendants. Defendants denied negligence.

Mr. Witt, Q.C., and Mr. Raymond appeared for the plaintiff, while Mr. Lawson Walton, Q.C., and Mr. Gray represented the defendants.

Plaintiff's case was that about 8 o'clock on the evening of February 23rd, last year, she was in Gee Street, St. Pancras, with her son and daughter, when an explosion took place through gas having accumulated in the culverts and street boxes through which the defendants' electric wires passed. Immediately after the explosion she trembled and felt a numbness of the feet. She became unwell, and some days afterwards she felt pains in her head and lost the sight of the right eye. She went to the Central London Ophthalmic Hospital, and after treatment extending over some months the sight of her eye was restored, though it was nothing like what it was before the accident. Plaintiff said the defendants were guilty of negligence in not properly ventilating the culverts and road boxes. She also alleged that the insulation was imperfect, and that in consequence of the defects in the defendants' system there was a risk of an explosion if coal-gas happened to get into the boxes. Defendants admitted the explosion, but said plaintiff was not injured by it. They also denied that they had been guilty of any negligence.

The jury returned a verdict for plaintiff, awarding £105 damages. Judgment was given accordingly. A stay of execution was allowed if the money was paid into court within a week.

GASKELL AND ANOTHER *v.* GOSLING AND SHARPE.

A DEFERRED judgment in the appeal in this action, reported by us in February last, when we noticed the arguments, was delivered on Wednesday last, the defendants, a London banking firm, having asked the Master of the Rolls and Lords Justices Lopes and Rigby to set aside a judgment of the Lord Chief Justice against them in respect to a supply of porcelain electrical goods to a firm over whom they held second debentures. The electrical apparatus firm of Poole and White, of Bread Street, London, in 1892 to secure some £3,000 they had overdrawn on their account with Gosling and Sharpe gave them second debentures for this amount and made them trustees under a debenture deed. In July, 1892, conceiving their security in danger, defendants put in a receiver and he carried on the business until 1895. Meantime, in September, on the petition of a creditor, a compulsory winding up order was made, and an official liquidator appointed. In 1893 the first debenture holders entered into possession of the undertaking and turned defendants' receiver out. Before his supersession goods to the extent of £490 had been supplied by plantiffs, a Longton, Staffordshire firm, to carry on the business and work up materials already in their possession, from the receipts of which the debenture holders were paid their interest. For this account they sued the defendants, and the Lord Chief Justice holding that they carried on the business through their agent, said they must meet the orders he had given; hence this appeal.

The MASTER OF THE ROLLS in a long judgment now said that he agreed with the Lord Chief Justice in holding the voluntary receiver to be an agent of the defendants. The company came to an end when the winding up order was made, and an official receiver was appointed. If defendants desired to be no longer responsible they should have discontinued to carry on the business; and were the decision to be other than the Lord Chief Justice had held, the plaintiffs might be deprived of the value of the goods defendants had received from them and sold. He did not shrink from this conclusion as applying to the present case, despite a recent decision of the House of Lords dealing with receiverships. He therefore thought the decision of the Lord Chief Justice should be affirmed, and the appeal from it dismissed.

LORD JUSTICE LOPES said he had arrived at the same conclusion, but LORD JUSTICE RIGBY dissented, thinking the recent decisions applied to the case, the appeal, therefore, was by a majority of the Court dismissed.

BUSINESS NOTICES, &c.

Agency.—Messrs. Fuller & Co., 28, Bush Lane, Cannon Street, London, E.C., inform us that they are now the sole agents for the Wenström direct and alternating current motors for the United Kingdom.

A Large Contract.—A trans-Atlantic exchange says that the National Underground Cable Company (U.S.) has just been awarded a contract by the Toledo Traction Company for all the underground cables to be used by them during 1896. This contract is said to be one of the largest ever given out in the United States, and covers cables for several kinds of service, including railway feeder, electric light and power distribution, and, when finished, will be the only system in the world in which series arc circuits and the three-wire system will be distributed from the same station. The distribution will be done from one immense central station, and the sizes of cables to be used run from No. 6 B. and S. G. to over 1,000,000 circular mils. The contract of the National Company covers also all the work of laying and joining and connecting of the cables, and the furnishing of all apparatus to be used in connection with the underground system.

Business Announcement.—Mr. Percy Dewhirst, electrical engineer, announces that he has severed his connection with Mr. E. Dewhirst, of Preston and Blackpool, with whom he has been associated for the last three years, and has commenced business on his own account at 90, Church Street, Blackpool.

Electrical Exhibition in Paris.—The Société Internationale d'Electriciens, of Paris, is organising an electrical exhibition to be held in that city in the rooms of the Société d'Encouragement, 44, Rue de Rennes, on May 2nd, 3rd and 4th.

Guatemala Central American Exhibition, 1897.—Although primarily a Central American Exhibition, the Government of Guatemala are desirous that foreign nations should take part in their Exhibition of Science, Art, and Industry, and a department will be assigned to them. It is proposed to hold the Exhibition in Guatemala next year, from March 15th to July 15th.

Messrs. Crompton's Works.—According to an exchange, Messrs. Crompton & Co. have now secured a site in Chelmsford, near Writtle Road cemetery, for the erection of new electrical works.

Tudor Accumulators.—Mr. A. B. Pescatore, of Manchester, who is the sole manufacturer of the Tudor accumulators in this country, has issued a revised and complete catalogue of his various types of manufacture. Tabulated details for easy reference are given of S, L, and H types stationary Tudor accumulators, and these particulars are followed by similar price list of portable cells, P type, for traction purposes, also T type for ship and train lighting, electric launch propulsion, &c. General instructions for working the batteries are at the end of what is a well arranged pamphlet, which will be found of service by those dealing in, or using accumulators.

ELECTRIC LIGHTING NOTES.

Bradford.—A Local Government Board inquiry was held on Tuesday into the application of the Corporation to borrow £40,000 for extensions in connection with the electricity works. The estimate includes site, £2,600; buildings, £11,500; machinery and fixing, £10,325 (engines £4,400, dynamos £2,650, boilers £3,000), and cables for changing mains from two-wire to three-wire system, £7,000. Mr. Gibbings, electrical engineer, supplied the inspector with a mass of technical information, and said that in January last the plant was 18 per cent. below the demand, and the demand was so rapidly increasing, that when the heavy pressure came on next winter, the plant would be 30 per cent. below the demand. There was no opposition to the application.

Birmingham.—The new General Hospital is to be entirely lighted by electricity. The contract for the wiring and fitting of the building has been placed with the Birmingham Electric Supply Company, Limited, the supply for lighting and power purposes being taken from the company's supply mains.

Bristol.—At the Council meeting on Tuesday, the report of the Electrical Committee, which recommended an expenditure of £75,000 upon extensions, was considered.

Cardiff.—A new temperance club in St. John's Square is fitted throughout with electric lighting, at a cost of £1,000.

Coventry.—At the last Council meeting Mr. Horton asked whether there would be any diminution in the noise at the generating station on the laying down of the new plant, the money for which was provided at the last meeting of the Council. Several complaints had lately been made. He understood there had been a diminution in the noise, but there was room for further improvement in that direction. Mr. West replied that the noise had been diminished very considerably, but any new plant that they had would run practically noiselessly.

Eastbourne.—A committee of parishioners of St. Anne's Church has been appointed to consider the question of ventilating, warming and electric lighting.

Exeter.—At a Council meeting last week, a letter was read from the Local Government Board, intimating that on being informed that the Board of Trade have definitely consented to the transfer of the undertaking of the Exeter Electric Light Company to the Corporation, the Board would be prepared to sanction a loan for the amount of the purchase money, viz., £7,500. The Board, however, would not be prepared to allow a longer period than 15 years for the repayment of this loan. The Town Clerk reported that the Board of Trade had expressed their readiness to consider an application for the revocation of the Exeter electric lighting order, 1891, with a view to the purchase of the undertaking under section 68. The Town Clerk was instructed to make the application for revocation, and to give the necessary notices. It is anticipated that the Local Government Board will sanction an additional loan of £3,500, for the purpose of putting the works in a proper state of repair.

Glasgow.—At the Corporation meeting this week, the deputations' report *re* their visit to other towns, and their recommendations *re* lamp posts, &c., were adopted.

Kingstown.—The Kingstown electric lighting provisional order was last Friday sent by the Examiner for second reading.

Lambeth.—We last week referred to the state of electric lighting affairs at Lambeth. We have now to report that at the Vestry meeting on Thursday last week, deputations were received from the ratepayers' and other associations. After lengthy discussion, the party which proposes to hand the powers over to Mr. Sax scored upon the first point, *i.e.*, rescinding by 54 votes to 32 a resolution passed by the Vestry in September last, deciding not to part with their powers.

Liverpool.—On Monday, the Liverpool Electric Supply (Transfer) Bill was considered in the Commons, and ordered for third reading.

Paisley.—Although tenders have been submitted for electrically wiring the Town Halls, and for a central installation, Dr. Bottomley having superintended the matter, the Town Council has decided not to take action at present.

Provisional Orders.—The Provisional Orders Bills for electric lighting for Gloucester, Wells, and other places, were the other day sent by the Examiner for second reading.

Railway Train Lighting.—The Caledonian Railway Company, after long inquiry regarding the various methods of applying electricity for the lighting of railway carriages, have given orders for an experimental train to be fitted up. In the first instance, the train will be run on some short local route in the neighbourhood of Glasgow, so that the new system of lighting may be kept thoroughly under observation. In the event of the trial proving satisfactory, the system will be extended to the passenger carriages of the company generally.

Stamford Hill.—The first cycling track in London permanently lighted by electricity has just been opened at the Tee-To-Tum Club, Stamford Hill. Six 2,000 C.P. arc lamps have been placed round the track on ornamental pillars, to enable cycling to be carried on after dark. The underground wires are paper insulated and lead covered, manufactured by the British Insulated Wire Company. Current is supplied from the plant for lighting the club premises, in which are installed 300 16-C.P. lamps. The plant consists of a 25-H.P. gas engine, and a Taunton dynamo. The whole of the work was carried out by Ball Brothers & Bates, of Holborn.

Bradford.—At a meeting of the Gas and Electricity Supply Committee of the Corporation on 17th inst., the Town Clerk reported that the joint objections of the interested bodies opposing the application for an extension of the three-wire system had been formulated and duly lodged with the Privy Council, with whom the decision rests. He explained the ten clauses of objection contained in the document.

Stafford.—In order to further encourage the use of electricity, the Council has decided to reduce the charge from 8d. to 4d. per unit for all current used above a stated average demand.

Thornaby.—The Corporation discussed the lighting question the other day. It was proposed that the present gas supply be reported upon, and also that the advisability or otherwise of making arrangements with any corporation or company for electric lighting be considered. The matter stands adjourned.

Walsall.—The Electric Lighting Committee recently reported that the total number of consumers supplied on March 31st last was 53; the total units generated at the station during the month of March was 8,039. The income for the month was £86 1s. 6d., less 2½ per cent. discount. The wages paid during the month amounted to £31. The value of coal consumed was £10 10s. They recommended that they be authorised to have the necessary cables, poles, fittings, and lamps required for lighting The Bridge, Park Street, the entrance to Bradford Street, and Lower Bridge Street, laid and fixed at an estimated cost of £621 10s. The committee have given instructions for the arc lamps required for the lighting of the streets referred to to be purchased from the Walsall Electrical Company, Limited, at a cost of £6 each, and for the lamp poles to be obtained from Messrs. Walter Macfarlane & Co., Glasgow, at a cost of £11 14s. 6d. each. The committee proposed that the necessary extension of mains in The Bridge, Bridge Street, Park Street, and Bradford Street, be laid by Messrs. Callender, Limited, at the prices named in the schedule of the contract entered into by them with the Corporation.

West Ham.—Six candidates for the post of electrical engineer were interviewed by the Council, Mr. Risch being appointed.

Westminster.—It is stated that the necessity for introducing the electric light in the Committee Rooms of the House of Commons has been brought under the notice of the First Commissioner of Works.

York.—The Streets and Buildings Committee, on Tuesday, decided to adopt Prof. Kennedy's report, and to request him to get out specifications for the purpose of inviting tenders.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Lugano Electric Tramways.—This interesting plant is now completed. All the tests have been carried out to the satisfaction of the owners, and it is expected that the line will be opened some time in June. This delay is occasioned by the fact that the telephone authorities are removing their wires from the neighbourhood of the trolley lines, and that they will not allow the cars to run until this has been accomplished. The power to run this line is supplied from an hydraulic installation at Maroggia, 12 km. from Lugano. The power plant is a 300-H.P. bell turbine, running at 600 revolutions per minute, with horizontal shaft, each end of which is directly connected to a 150 H.P. 3-phase generator, working at pressure of 5,000 volts, and with a periodicity of 40 cycles. The current for the tramway is carried by three bare copper wires, 5 mm. in diameter, to a transformer station situated as near the centre of the line as possible, and where the current is transformed down to 400 volts. As shown in the illustration, a double trolley wire and two trolley poles are used, the rails being used as a third conductor. One three-phase motor is fitted to each car, and is connected to the axles of it by means of single reduction gear of one to four. The motor has 12 poles, and makes 400 revolutions per minute. The armature has three sliding rings, by means of which a resistance can be put in series with it. The maximum pressure in the armature never exceeds 60 volts. The gauge of the line is one metre. There will be four cars running, and the total length of track will be 5 km. The wheel base of the cars is 4 feet 6 inches and carry 24 passengers, 8 seated, and 8 on each platform. The insulation used for the trolley line is the well known "Aetna" type, and the trolleys used are known as the Boston pivotal trolleys. The working of this line will be watched with great interest, as it is the first practical application of three-phase motors to traction purposes. Should this line prove as successful as its builders, Messrs. Brown, Boveri & Cie anticipate, there is little doubt that there will be a wide field for the application of this system, especially in connection with light railways, and lines going far out into the suburbs.

The Three-Phase System at Lugano.

Baker Street and Waterloo Railway.—A financial contemporary states that the opposition threatened to the Bill promoted by the Baker Street and Waterloo Electric Railway Company has been withdrawn. By this Bill, which will now pass unopposed through the Commons, powers are granted to the company to construct a short extension of their authorised line so as to connect with the London terminal station of the Manchester, Sheffield and Lincolnshire Railway Company. The additional share and loan capital granted is £100,000.

Blackpool Tramways.—The Corporation of Blackpool have lodged objections to the *locus standi* of the Blackpool, St. Anne's and Lytham Tramways Company, and the Lancashire and General Tramways and Carriage Company, both of whom have presented petitions against the Blackpool Improvements Bill. These petitioners object to the powers sought by the Corporation to continue to work the tramways in the borough, upon the ground that they are prepared to take a lease of the lines upon terms to be fixed by the Board of Trade. The Corporation contend that an offer made by these companies and refused by them does not entitle them to be heard against their Improvements Bill.

Bray Proposed Electric Tramway.—At the Town Commissioners last meeting a deputation representing the British Electric Traction (Pioneer) Company, attended with reference to the construction of a system of electric tramways throughout the township. Mr. Ryan, C.E., explained the proposed route, and Mr. E. Garcke said he was prepared to give the Commissioners every guarantee as to the financial position of his company. They were prepared to carry out the work and maintain and work the tramways so as to give satisfaction to the Commissioners, and he hoped profit to themselves. He desired, however, before his company went to the expense of advertising the scheme, to know if the Commissioners were in favour of the proposal. The Commissioners decided to hold a special meeting early next week to consider the matter.

Dover Electric Tramways.—From the *Dover Standard* we gather that another step forward has been taken in regard to the Tramways scheme. Major Marindin, the Government Inspector, has been to Dover to examine into the scheme, and he is so satisfied with everything that the Board of Trade will not consider it necessary even to hold a local enquiry. This is very satisfactory all round. All that is now needed is the Royal Assent to the Act, which the Corporation applied for, and the *Dover Standard* hopes to see something tangible in the shape of tramways before 12 months have elapsed. From what our contemporary learns, the overhead electric wire system is likely to be adopted.

Glasgow and Electric Tramways.—An elaborate and illustrated report has just been issued, giving the results of an investigation made on the Continent by Councillor Crawford and Mr. John Young, the general manager of the Glasgow Corporation Tramways, into the best recent installations of mechanical motors as applied to tramways. Councillor Crawford and Mr. Young, in accordance with the remit made by the Tramways Committee on February 21st last, spent over three weeks in making a thorough inspection of some of the most interesting and instructive examples of mechanical tramway traction, and their report consists of some 59 pages. The cities reported upon are Brussels, Hanover, Hamburg, Berlin, Dresden, Budapest, Vienna, Milan, Paris, and Rouen. The deputation give a record of facts and information collected by them regarding the various installations they inspected, adding thereafter general remarks and conclusions. After considering the various objections to overhead wire systems, the reporters state that they have come to the following conclusions:—1. "That the time has arrived when the Glasgow Corporation should make arrangements for beginning, as soon as they conveniently can, to work some of the tramways by mechanical traction. 2. That the overhead system of electric traction is the best we have seen, and can be made quite applicable to any part of the city. 3. That the Corporation should begin by testing this system on one important route. The increasing traffic is sure to require further extensions of the tramway service before next summer, and if a trial line, as suggested, could be ready for working next spring, this would save further extension of the present system, and give the Corporation an early test of mechanical traction. 4. That, in the erection of the overhead lines, the cross-span wires should be fixed to buildings wherever possible. 5. That the installation at Hamburg, being the largest installation of electric traction in Europe at present, is one which should be specially included in the list to be inspected in terms of minute."

Hartlepool Electric Tramways.—A satisfactory trial of trams on part of this new line took place on Tuesday morning. An early opening is anticipated.

Proposed Electric Tramway for Edinburgh.—The Council has remitted to the Lord Provosts' Committee to consider the advisability of constructing a circular tramway at or near the proposed extended boundary of the city to be worked by electric or other motor, and connecting the routes already sanctioned.

The Light Railways Bill.—The Grand Committee on Trade of the House of Commons, at the end of last week, considered the Government Light Railways Bill. Various amendments to certain clauses were moved, and the committee adjourned. Regarding one of the amendments, Mr. Bryce thought it would be a dangerous responsibility to throw upon any department to decide upon applications from a local authority or a private company, and it would be necessary, therefore, to insert between the local authority and the board a tribunal such as was proposed by these Commissioners. It would be a dangerous change if they were to leave it to the Board of Trade alone.

Tramway Bills in Parliament.—In the Commons on Monday last the Belfast Street Tramways Bill, the Dublin Southern District Tramways Bill, and the Portsmouth Street Tramways Bill were read a second time. The motion for the second reading of the City and South London Railway Bill was postponed till Friday.

It is understood that half-a-dozen members have notified their intention to move the rejection of the Bill. Should the second reading be carried, Mr. Richards will continue the opposition by proposing an instruction to prevent the railway from interfering with the church of St. Mary Woolnoth, close to the Mansion House, the promoters having scheduled the site for the purposes of the undertaking.

Zurich Electric Tramways.—The Swiss Government has given a concession for the electrical transformation of most of the existing horse lines of the town of Zurich into trolley lines. A new line is also to be built from Zurich to Oerlikon and Leebach. The gauge will be 1 millimetre, and the fares will be one penny for the first kilometre and one half-penny for each following kilometre. The concession for this line has been given to the Machinenfabrik Oerlikon. As is already known, there are two most successful trolley lines running in Zurich.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
" " (P.Q.) ...	June 24th, 1895 ...	...
Brest-Penzance (P.Q.) ...	... ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Assab-Massowah	March 29th, 1896 ...	April 18th, 1896.
Guernsey-Jersey	April 8th, 1896 ...	...
Landlines.		
Communication with Matagalpa Provinces of Leon and Chinandega ...	Feb. 26th, 1895 ...	...
Trans-Continental line beyond Mazol (Mashonaland) Telegrams for Tohikwawa and Blantyre cannot be accepted.	March 12th, 1896 ...	...
Saigon-Bangkok	April 20th, 1896 ...	April 20th, 1896
	April 20th, 1896 ..	April 21st, 1896
	April 21st, 1896 ...	...

The Electrophone.—On Monday evening, at Marlborough House, their Royal Highnesses the Princess of Wales and Princesses Victoria and Maud, through the electrophone, listened to popular selections from the leading London theatres, &c., including part of the Opera at Drury Lane. The installation is fitted in the private boudoir of Her Royal Highness the Princess of Wales, and the hearing afforded much enjoyment.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—June 1st. The municipal authorities of Prague are inviting tenders for the erection and equipment of a municipal electricity generating station in the town for electric lighting, power, and tramway traction purposes. Tenders are to be directed to the Stadrath der Haupt, Stadt Prague, Prague, Austria, from whom full particulars may be obtained.

Baildon.—Tenders are invited for the supply and erection of an electric lighting plant at Ferniehurst, Baildon (Shipley Station). The plant will comprise gas engine, dynamo, switchboards, storage battery, and wiring for about 180 incandescent lamps. Contractors are at liberty to tender for any portion of the work. Particulars, &c., from the engineer, Mr. A. Bernstein.

Belgium.—May 9th. Tenders are being invited by the Provincial Government authorities at Bruges, for the supply and installation of several electric water-level indicators. Tenders to be directed to the Gouvernement Provincial at Bruges.

Belgium.—May 27th. Tenders are being invited for the conversion into electric lines of about 20 kilometres of "Vicinal" steam railways in the Centre district. Tenders are to be sent to the Société Nationale des Chemins de Fer Vicinaux, 26, Rue de la Suence, Brussels, where full particulars may be had for the sum of 1 franc.

County Antrim.—May 1st. The Commissioners for the control of Lunatic Asylums invite tenders for the supply and erection of an electrical installation at County Antrim Lunatic Asylum.

Coventry.—May 12th. The Corporation invites tenders for the supply and erection of boilers and other plant for the boiler house, also steam engine, alternator, fittings, &c., for electric lighting. For further details, see our "Official Notices."

Eston.—May 1st. The District Council invites schemes for lighting the district by electricity, such schemes to embrace (*a*) plan and estimated cost; (*b*) annual working cost and maintenance. Particulars from the District Surveyor, Grangetown, Yorkshire.

France.—The French Admiralty authorities at Brest are at present inviting tenders for the supply of three steam dynamos intended for the electric lighting of the French cruiser *Gaulois*.

Hampstead.—April 27th. The Vestry invites tenders for the supply and erection of a 300 k.w. steam alternator, switchboard, steam and exhaust pipes, &c., for the Stone-yard Central Station. For further details, see our "Official Notices."

Lima.—June 1st. The Municipal Council is inviting tenders for the establishment and working of the electric lighting in the squares and streets of the city, with power to work the private supply under a 20 years' contract. Particulars to be obtained at the Peruvian Legation, 13, Comeragh Road, West Kensington, W.

London, S.E.—April 29th. The Newington Baths and Wash-houses Commissioners require tenders for engines, shafting, &c., also electric lighting machinery for the baths and wash-houses now being erected in Walworth. Details from E. B. l'Anson, 7a, Lawrence Pountney Hill, Cannon Street, E.C.

London, S.E.—May 6th. Tenders are invited for the provision and fixing of electric bells, telephones, fire alarms, &c., at the Brook Fever Hospital, Shooter's Hill, S E., for the Metropolitan Asylums Board. Particulars can be obtained at the chief offices of the Board on and after 16th inst. upon depositing £5.

Oldham.—May 1st. Tenders are wanted by the Technical Education Committee for the wiring of the Technical School. Ascroft Street, Oldham. The installation will consist of 34 arc lamps, For further details see our "Official Notices."

Portugal.—May 6th. The Royal Company of Portuguese Railways is inviting tenders for the supply of material required in connection with the electric lighting installation. Particulars may be had from the offices of the company at 28, Rue de Chateaudun, Paris. Tenders to be sent to the Ingenieur Chef du Service des Magasins, Compagnie Royale des Chemins de fer Portugais, Santa Apolonia, Lisbon.

Sunderland.—April 29th. The Corporation invites tenders for an evaporative tubular surface condenser with air and circulating pumps. For further details see our "Official Notices."

CLOSED.

Bradford.—The following tenders, for works in connection with the Corporation new electricity supply station, have been accepted:—

Accumulators.—The Epstein Electric Accumulator Company.
Surface-condensing plant.—Messrs. Cole, Marchent & Morley.
Cables, &c.—The British Insulated Wire Company.
Travelling crane.—Messrs. J. Booth & Bros.
Steam and exhaust pipes.—Mr. John Spencer.
Ironwork (gates, railings, &c.).—The Coalbrookdale Company, Limited.
Reservoir and tank.—Messrs. Broxup & Sons.
Flooring:—The Wood Block Flooring Company.

Also a number of other tenders for carpentering, painting, plastering, plumbing, &c.

Edinburgh.—The Town Council has accepted the tender of Messrs. Lowden Bros., of Dundee, for wiring the City Chambers for electric lighting, for £188.

Glasgow.—For the supply of a dynamo to be installed at the Dalmarnock Sewage Works, the tender of the General Electric Company has been accepted. We hear that the additional power plant for the Waterloo Street Electric Station is to be supplied by Messrs. Siemens Brothers & Co., Limited, the contract price being £4,560.

Harrogate.—From the tenders submitted for steel roofs, girders, &c., for the electricity generating station on the Corporation farm, near Harrogate, for the Corporation, that of Messrs. J. Abbott and Co., Limited, of Gateshead, at £623 4s. 9d., has been accepted.

Walsall.—As stated in our "Electric Lighting Notes," the Council have given the contract for arc lamps to the Walsall Electrical Company, Limited, for lamp poles to Messrs. W. Macfarlane and Co., and for main extensions to Messrs. Callender's Company.

NOTES.

Electrical Standards.—In the House of Commons on Tuesday, Colonel Mellor asked the President of the Board of Trade whether the Board could offer the same facilities for testing and checking electrical standards as is given by the German Government, with so much advantage to the German manufacturers of electrical apparatus. Mr. Ritchie said the Board of Trade had caused new denominations of standards for the measurement of electricity to be made and verified, and they now have under consideration the best method of affording facilities to manufacturers and others for comparing their instruments with those standards.

A Year's Transmission Work at Niagara.—Mr. Orrin E. Dunlap, writing in the *Western Electrician*, summarises the first year's work in electric power transmission at the Niagara Falls. Since the first great turbine was started on April 4th, 1895, two others have also been successfully erected. The writer says that the year has seen the construction of proper conductors to convey the power to the point of application, and consequently the erection and operation of several factories on the lands of the Niagara Falls Power Company. These buildings comprise the carborundum plant and an aluminium plant, to which repeated reference has been made in the ELECTRICAL REVIEW, a carbide factory, and a potash and sodium works. In addition to these, the power from the mighty generators is being used for operating the Buffalo and Niagara Falls Electric Railway, the several electric lines in the City of Niagara Falls, and it is also being used to light Niagara Falls. Other factories are in process of erection, all demonstrating that the first year of application of power from the huge dynamos has been an unqualified success. An extension is being made to the carbide plant. In the upper river plant of the Pittsburg Reduction Company, the foundation has been built for the first 600-kilowatt transformer, which is one of the steps toward the enlargement of the plant. The machine was expected to arrive during the present month. The Carborundum Company is about prepared to start its kilns and the manufacture of its various goods. As a result of the hearing on the Bill relating to the power to be legally enjoyed through the hydraulic canal development, the Bill has been amended to allow of the development of 100,000 horse-power, instead of 200,000, as at first framed. In the new potash and sodium works foundations have been built for two 250-horse-power transformers. The new plant of the Niagara Electro-Chemical Company, on the grounds of the Niagara Falls Power Company, is being built. When completed, the works will cover a plot of ground 300 by 250 feet.

Testing Rail Bonds.—A new method of testing the resistance of rail bonds, suggested by Mr. Harold P. Brown, has been carried out very successfully on the "Gorge Road," Niagara Falls. As was intimated in our last issue, the track is seven miles long, and the rails 30 feet in length, and by this method every bond on the track was tested in two hours. The plastic bond is used on this line, and it was found that with a current of 100 amperes there was a drop of only 0·005 volt at each joint, or about one-eighth that of a new copper bond. The plan adopted for making the tests was to lash two cars together by a wooden beam at a distance of 20 feet. This left just 28 feet between the rail contacts of the rear wheels of No. 1 car and the front wheels of No. 2 car. These trucks were then connected by an insulated wire, in which was interposed a very low reading voltmeter. A high reading voltmeter was placed between trolley and rail, and an ammeter put in series with the motors. Then the motors of No. 1 car were started, and brake set on No. 2 car until 100 amperes were required to run the cars at about three miles an hour. It is evident that, as the train moved away from the power house, the low reading voltmeter would indicate the drop in pressure due to the resistance of the rails and joints between the cars. The rail joints are placed in the centre of the opposite rail, and therefore during a movement of 2 feet the rear truck of No. 1 car and front truck of No. 2 car were on the same rail, while there was a joint between them on the other rail. During the next 13 feet there was a joint in each rail. The consequent variation in the voltmeter's reading represented the increase of drop due to one joint. At its lower point, which would be held for about one-half a second, the reading represented the drop due to 28 feet of unbroken rail, in parallel with a similar length of rail having one joint and a pair of plastic bonds. For the next 3½ seconds the reading would be higher, since there was a joint in each rail. Knowing the drop per foot of rail with a given current, the readings were easily verified by calculating the total drop and comparing it with the indications of the high reading voltmeters on the car at the end of the line and at the power house.

Vacant Appointments.—The Great North of Scotland Railway Company require an electrical engineer for electric lighting and telegraph work. Salary £250 per annum. For further details see our "Official Notices."

Applications for the post of electrical engineer to the Blackpool Corporation have to be lodged by Monday.

The Statue of St. Fidèle at Palazzole sull' Oglio.—We (*L'Eclairage Electrique*) have already mentioned the gigantic statue in galvanised copper of St. Fidèle, made at the art works of Count Vittorio Turatti for the industrial applications of the galvano-plastic process. It is erected at the summit of the People's Tower in honour of St. Fidèle, the patron saint of the town. St. Fidèle was a Roman soldier, and one of the first of the Christian martyrs. The statue was moulded in clay by the sculptor Rassi. The sculptor's work was moulded in plaster at Turatti's workshops. The mould was in 17 pieces, without counting the accessories, lance, palm, sword, &c. Each part was treated with plumbago, and furnished with a framework of metallic wires following its outline, intended to increase its conductivity, and to facilitate the deposit of the first layer of metal. When once this first layer had been deposited, the framework of wires was taken away. In certain parts, however, it was allowed to remain, and was itself covered with copper, so as to form an armour plate to the part it outlined. The deposit is pure copper. The current was furnished by a dynamo of 600 amperes and 4 or 6 volts, driven by a 4 H.P. gas engine. The statue is 7 metres high; it has an external surface of about 40 square metres; the deposit was about 4 millimetres thick. The entire weight of the statue is 800 kilogrammes. It would have been very difficult to carry up this colossal statue to the top of the tower, and still more so to fix it in position; it was therefore divided into five parts, the legs, the trunk, the head, and the arms. The accessories were added afterwards. Each part is formed of two, three, or four pieces, soldered strongly together with zinc and tin. The different parts are joined by being made to dovetail into one another; these dovetailed parts were formed during the galvano-plastic operation, and are held together by screws. The statue is strengthened by an internal framework of wood; two iron rings placed at the waist and the shoulders serve to render the whole firm. Owing to its prolonged immersion in the galvano-plastic bath (10 to 12 days) the outer surface of the copper has become oxidised, and presents the aspect of bronze. The cost of this statue amounts to about 8 or 10 francs the kilogramme.

An Appreciation of Helmholtz.—At an extra meeting of the Chemical Society, Prof. G. F. Fitzgerald, M.A., F.R.S., of Trinity College, Dublin, delivered the Helmholtz Memorial Lecture. The position of the work of Helmholtz was considered with special reference to its chemical aspects, and the later work that had been grafted upon it. Some of the valuable points in the vortex atom hypothesis of matter were noticed, and some of its serious difficulties considered. Analogies on this hypothesis to the asymmetric carbon atom and to the benzene ring were pointed out. The applications of thermo-dynamics to chemistry were noticed, and a theoretically perfect, semi-permeable diaphragm for non-volatile salts in solution, in which the actions at all points are known, was described. The theory that a substance in solution is like a substance in the gaseous state, was criticised, and it was contended that from Helmholtz's work, and on dynamical grounds, the conditions could not be alike. The theory that there was combination between the solvent and body in solution was put forward as a complete explanation of the known phenomena of solution and electrolysis. It was pointed out how Helmholtz had, by his work, made important steps forward in several directions towards a dynamical explanation of Nature. In the discussion which followed, the President, Sir Joseph Lister, P.R.S., Dr. Edward Frankland, Lord Rayleigh, Sir Henry Roscoe, Prof. Poynting, and Prof. Fitzgerald took part.

Most Wonderful Remedy of the Age.—We are pleased to see that in its last issue *Science Siftings* has focussed its searchlight upon another object. This is the "new discovery" of the World Medical Electric Company, Temple Chambers, E.C. After stating that the appliances will cure all the ailments which form the stock-in-trade of quacks advertisements, we are not surprised to learn in the light of the shocking epidemic which has turned the city of Gloucester into a plague-stricken spot, that they are "an absolute preventative of small-pox and cholera, and all other infectious diseases." It is not for us to comment upon the extraordinary want of appreciation of the benefits of vaccination which has characterised those in authority at Gloucester; we will simply give the "analysis" of the appliance (standard price 12s. 6d.) which our contemporary has ruthlessly made:—"A pear-shaped pad is made in the following way:—First, is a layer of some white lining stuff, then a layer of white absorbent paper, on top of which is a piece of black wool. Then comes a few pieces of zinc and copper *tied together with black cotton*, and separated (we cannot describe it as insulation) with bits of black cloth. On top of the whole is a drug which, on examination, proved to be sulpho-cyanate of allyl, or, in plain English, the active ingredient of mustard seed. A piece of black cloth covers these multifarious trifles, and the whole is bound together with common black braid, and pierced at the top with an eyelet to take a piece of black cord for hanging the object (which is 5 inches long) round the neck. Such a contrivance is naturally incapable of generating electricity, but it *is* capable of irritating the skin through the agency of the mustard seed oil (kept moist by means of vinegar), and thus creating a misleading impression that it is an active curative agency for all the ills enumerated. In short, its virtues are limited to those of the ordinary mustard leaf (notwithstanding its pretentious designing), and every housewife knows what those are."

The Bishop, the M.P., and the Doctor.—The City of Bangor is fortunate in possessing a Bishop who supports the proposed electric light scheme in face of all opposition, who will have the light at the Palace at any reasonable cost, and who also states that it will be adopted at the Cathedral and the Training College. Now at Bangor, be it known, there groans a strong party which would do anything and everything in its power to keep the electric light away; and at the recent Local Government Board inquiry which was held regarding the application of the City Council for a provisional order, Mr. E. J. Griffith, M.P., who was championing the cause of the opponents, handed in a petition against the scheme signed by 10 members of the Council. The worthy Bishop of Bangor was present to support the scheme, and the following little bit of cross-examination, in which the M.P. got decidedly the worst of it, caused a good deal of merriment:—

Mr. Griffith: Do you know that electric light would cause noise, smoke, and vibration?—No. You did not know that?—No; I know that the manufacture of the electric light might cause noise, smoke, and vibration, but not the light itself (great laughter). He paid about £20 a year for gas for the Palace, and about £80 a year was paid for gas for the Cathedral.

Another neat little piece occurred in the evidence of Dr. Price against the scheme. He said:—

Had the objectors realised that the electric light scheme was so imminent, they would have made it a test question at the last election.

Mr. Marshall (representing the City Council): But you had a bye-election after your eyes had been opened to the imminence of this scheme. Why did you not raise the question then?

Dr. Price: One candidate was an electric light man, and the other was not (loud laughter).

We should have thought that an admirable opportunity to make it a test question!

Crystal Palace School of Engineering.—The certificates gained for the Easter term by the students of the Crystal Palace School of Practical Engineering were distributed on Friday last, 17th inst., by Mr. A. T. Walmisley, M.I.C.E., of Dover. The ceremony, after an inspection of the school, took place in the lecture hall. Mr. R. G. Hodson (superintendent of the Crystal Palace School of Art, Science, and Literature) read the reports of the examiners, who were Mr. J. E. Darbishire, M.I.M.E., Mr. G. Maxwell Lawford, A.M.I.C.E., and Mr. J. Grice Statter, A.M.I.C.E. Favourable opinions were expressed with respect to work done in the mechanical and civil engineering sections of the school, as well as in the electrical engineering department. In addressing the students, Mr. Walmisley said that the Crystal Palace, besides being an excellent place of entertainment, carried on valuable educational work, of which the School of Engineering, started in 1872, was a specimen. Students who had passed through the School were now doing useful service all over the world. After the distribution of the awards, the usual vote of thanks were passed to the examiners, and to Mr. Walmisley for presiding.

A Cotton Mill Transmission Plant.—The Pelzer Manufacturing Company, of South Carolina, have recently built a new mill. It contains 55,000 spindles and 1,400 looms, and is the largest mill in the Southern States. Its size is just about that of an ordinary Oldham mill, with engines of 1,000 H.P. for the mill, exclusive of the power for the looms. To drive this No. 4 mill, there have been installed at a point about 2½ miles distant three three-phase 1,000 H.P. generators of 3,300 volts each, which supply current for the mill and the looms; for 1,200 incandescent lamps a 400 H.P. motor to drive No. 3 mill and two 5 H.P. pump motors. The new mill altogether absorbs the power from 21 induction motors; the line is 2⅝ miles long; and the water power is of 5,000 H.P., and has been secured by a dam of solid masonry giving a fall of 34 feet, and actuating Victor turbines of horizontal type, running at 167 revolutions per minute. The line is carried on poles of cedar 40 feet high, with two "buckthorn" wires on the top arm as lightning protectors, and grounded at every third pole, and there are six copper conductors on each of the three next lower cross-arms. On the lower cross-arm are strung the pressure and telephone wires, and specially large glass insulators are employed. The transformers are cooled by air blown by two 5 H.P. motors, and the current as supplied has a pressure of only 200 volts at the motors, which are carried on the ceilings. As common in America, the looms are in the mill building, not in sheds as in English practice, a necessity of the climate. The 720 looms on one floor are operated by four 110 H.P. motors, which drive the floor above also with its 680 looms and five slashing machines. The third floor (preparation machinery) calls for three 110 H.P. motors and the spinning room above has eight motors also of 110 H.P. There are two motors of 50 H.P. in the basement to drive the openers, and four of 75 H.P. in the picking room on the first floor. The guaranteed efficiency from turbine shaft to motor shafts is 80 per cent., so that we may assume there is provided 2,400 H.P., or, abstracting the 400 for No. 3 mill, about 2,000 H.P., which is a fair, but not an excessive amount, for a mill of this size, with lighting included. In all the place there is no belt wider than 8 inches, no pulley larger than 30 inches, and no long shafts. By adopting electrical transmission, the company have got their new mill at the same site as the older mills, at the same village, have saved 2,500 tons of coal annually at No. 3 mill, and have avoided costly foundations necessary, had the mill been at the dam, as well as a three miles railroad branch. In fact, the whole seems an illustration of electrical transmission at the right place.

Use of Water Separators in America.—The tendency in America, where boilers are so much used of the water tube type, is to use water separators of large size, which serve as reserves of steam close to the engine. The United Electric Light and Power Company, of New York City, have recently applied four Stratton separators to their 1,200 H.P. of Westinghouse engines, and report that the pressure variation as between the engine and boilers scarcely varies, and the pulsation in the steam pipes is practically stopped, as proved by the practical abolition of all vibration.

West African India-Rubber Supply.—According to statistics recently published, the total trade of Lagos amounted last year to £1,834,357, showing a considerable increase over the figures for 1894. Of this amount, £999,857 represent exports, and the remaining £834,500 imports from the United Kingdom, Germany, the United States, and France. Perhaps the most surprising feature in the development of trade in this flourishing West African colony is the marvellous increase of the rubber industry. Five years ago the total quantity of rubber exported from Lagos did not represent in sterling more than £8,500; in 1895 it has reached the amazing figure of £272,000. This speaks volumes for the future of Lagos, and will be a double incentive to the Government to push on the railway with all possible speed. This very noticeable increase in the quantity of India-rubber exported from Lagos is almost entirely due to the special attention given to the development of this industry by Sir Gilbert Carter, who has been Governor of Lagos since 1892.

Unscientific Imagination.—Tyndall long ago demonstrated to us that the imagination has its legitimate use in promoting scientific progress, but when the uninformed man gives it rein, or the ambitious man attempts to predict the erratic course of human evolution some thousands of years ahead, we feel inclined to resent it—we have asked for bread, and have received a stone. A writer in the *Electrical World*, N.Y., on "Probable Developments in Electricity and Electrical Engineering," gives rise in us to some such feeling. Here, for example, is a sample:—"Since using Langley's figure of ⅓th watt per centimetre as the energy received at the surface of the earth on a bright summer day, the total amount of energy received by an area 100 yards square amounts to 20,000 horse-power, it is evident that it will not be long before some means be found of utilising it. For instance, by placing on such an area a tank with a roof pervious to heat and light, the tank containing a gas which is dissociated at the temperature obtainable in the tank, and which is capable of being used, after dissociation, in a voltaic cell." Considering the present state of electrical knowledge, could anything more impracticable or improbable be imagined? Up to the present all attempts to produce a useful gas battery have failed; and before dissociated gases can be used in a gas battery, the positive and the negative constituents must be separated. Even granting that there were no theoretical impossibilities in the way, the cost of such an installation for obtaining power would be so great, that it would pay the inventor much better to convert his 100 yards square into a market garden. We need not, therefore, be surprised to find this writer stating further on:—"We need a general method for solving differential equations, so that physical problems may be attacked without the necessity of so much ingenuity as is now requisite. Also an agreement among mathematicians as to the best form of vector methods." After that, the millenium. The inventor need then only know what he wants, insert this as a constant in his differential equation, the solution of which will show him how to get it. This writer does not appear yet to have discovered that the principal occupation of mathematics is to explain, and make definite, what has already been discovered by experiment, and rarely, indeed, to discover any new fact.

Electric Elevators.—A short leading article, on elevators, which recently appeared in New York *Electricity*, seems to refer entirely to the use of such machinery in one particular building, where it was determined to embody some entirely novel features. We gather from our contemporary that these novel features have not been successful so far, or have not been correctly adjusted as yet. While lift manufacturers would not object to anything which promotes the success of the electric elevator, we think they would be justified in protesting, in common fairness, against the conclusions which appear to have been drawn by the writer of the article referred to. Because the particular hydraulic elevators in question have given the results stated, the writer of the article says "Their failure, therefore, would seem to indicate that the hydraulic elevator has its limits, beyond which it is not safe to try it, and that those limits are exceeded in our high office buildings." The conclusion drawn by the writer is not justified. The building in question, we believe, is a very high one; it is probably the highest in New York, but of this we are not quite certain. It is, however, not the highest building in which elevators have been fixed. It will be within the knowledge of many that a London company fixed hydraulic elevators in the Eiffel Tower at Paris, which had a travel from the ground to the second floor—a distance of about 450 feet. This distance is undoubtedly much higher than that of the New York building. Moreover, they had power to lift a load of 50 passengers, which is, no doubt, far beyond the power of the New York lifts. We believe makers are ready to erect hydraulic elevators to work to any height, to have any required power, and to travel at any required speed. It is going altogether too far to say that hydraulic elevators have a limit and are a failure because four, or possibly half-a-dozen elevators, have not given a good result because of some special features never tried before, when there are perhaps 30,000 entirely successful hydraulic elevators. From the article to which we refer, it would seem that there is animus on both sides in New York.

Platinum in New South Wales.—Mr. J. B. Jaquet, geological surveyor, has forwarded to the Mines Department a report upon the newly discovered platinum deposits at Fifield, about 26 miles north-east of Condobolin and 54 north-east of Parkes. The report says that platinum has previously been recorded as occurring in the colony in the sea beaches between the Richmond and Clarence rivers, in ironstone and decomposed gneiss near Broken Hill, and grains of the metal have not infrequently been met with by miners working various auriferous drifts. However, until the opening up of the Fifield platina deposits there had been no production upon a commercial scale. The field was first opened up in 1893, though the presence of platinum was recorded many years previous to this by Mr. T. F. Connelly, who received Government aid to prospect the district. The formations represented are silurian slates intruded by diorite, and fossiliferous sandstones and limestones of Devonian or Silun-Devonian age. The platiniferous lead is a little over a a mile long. It varies in width from 60 to 150 feet, and is covered with from 60 to 70 feet of loam. The precious metals are practically confined to the bedrock and the drift for three inches above the bottom. Nuggets which weighed from a few grains up to 5 dwt. have been occasionally found. The crude metal contains about 75 per cent. of platinum, and realises at the present time upon the field 24s. per oz. The quantity of platinum per load of washdirt varies from 5 dwt. to 12 dwt., while the total value of precious metals per load varies from 9s. to 37s. In the vicinity of Fifield, at an elevation of over 100 feet above the lead now being worked, beds of cement and indurated ferruginous shales occur, which are of a Tertiary age or even older. These beds contain a little gold and platinum, but not where hitherto explored in payable quantities. Mr. Jaquet is of opinion that the precious metals in the recent deposits have been derived from these older conglomerates; that the latter have been disintegrated and ground-sluiced by nature, and the deposits now being worked represent the resultant concentrates. Other beds containing platinum and gold probably occur in the vicinity of Fifield and Burra Burra. The prospecting of these flats, however, will be a tedious operation, since they are for the most part of great extent, and there is nothing upon the surface to indicate the path of gutters below. The development of the field has been much retarded by dry seasons, and the consequent shortage of water for sluicing purposes. The Fifield platina lead has already yielded 1,200 ozs. of platinum, and the gold obtained upon the whole field since 1893 totals about 1,800 ozs. At the present time 7,000 loads of washdirt, representing about 3,500 ozs. of platinum, are dumped around the various claims awaiting treatment.

He Knew His Business.—There is a certain superintendent of a large cable railway who is noted for the rapidity with which he reaches a decision and the promptness with which he acts upon it. In fact, says *Dixie*, he is a continual object lesson to all who know him. Some time ago he was driven almost to distraction by the number of flat wheels that were formed, running to five, six and seven pairs a day. The wheels were from the same foundry where the company's wheels had been purchased for years, and there was nothing in their appearance to indicate anything wrong with them. No change had been made in the brake leverages, and the cause of the flat spots was undiscoverable. One day he boarded a car, and was watching the gripman. There are two brakes, a lever, and spindle brake. The latter has a ratchet handle and a holding ratchet on the floor. He noticed that when the brake was set, the gripman would allow the ratchet handle to fly back, and then thinking the brake off would set the grip. The cause of the flat spots was at once apparent—the lower dog was holding the brakes set, and the cable was dragging the sliding wheels. Our superintendent was riding towards his shops, which were distant about 25 minutes; but in 25 minutes a good many wheels might be slid flat. So he jumped off the car, went into a telephone station, and gave instructions to have a force of men go out at once and take off all the floor dogs from the spindle brakes, and then resumed his trip. His men never delay in the execution of his orders, and in a little more than an hour all the ratchets were off and no more flat wheels have been reported. It is a good example of quick thinking and prompt obedience.

Are We Played Out?—The serious inroads which the competition of Germany and Belgium has been making upon fields which were supposed to be firmly controlled by the English manufacturers, have stirred up the British traders to make special inquiry into "the methods and conditions under which Continental manufacturers were enabled to compete so successfully with those in this country." The deputation was composed of both employers and employed. It appears that the cost of raw material, such as coal and pig iron, differs very little in England, Germany, and Belgium; and that it is in the process of manufacture that the Continental firms show such superior economy. The following figures will show how fast these nations are gaining upon the British manufacturer. In 1882 Great Britain produced 8,493,000 tons of iron, against only 3,380,000 tons produced in Germany. Since then the annual German production of pig-iron has advanced to 5,380,000 tons, while the British production of pig-iron has fallen to 7,364,000 tons. Germany's output of finished iron has in the same time increased from being only half the British output to more than equality. Belgium has not in the same period made anything like the same relative progress as Germany, but the output of Belgian steel has, nevertheless, more than doubled during the last 10 years. The report ascribes the rapid development of the Continental iron industry to the "steady character of the workmen," and to the fact that strikes are very rare among the German operatives. The delegates were impressed with "the splendid discipline maintained," and the military exactness and regularity in the performance of order. There can be little doubt that the universal military service in Continental countries reacts favourably on industry, in this respect at least. Anyone who has studied the large German manufactories must have been struck with their almost military organisation, and the absence of that divided responsibility which is the *bête noir* of some of the large companies on this side.

A Warning.—The itinerant vending of incandescent lamps, good, indifferent, and bad, but probably mostly the latter, is a calling that is bound to exist and to increase as time and electricity roll onward, if in any degree encouraged by consumers. The result of these little transactions is not always profitable to all concerned, and is fraught with a certain amount of danger, and certainly much inconvenience. Only the other day we heard of a city firm which is in the habit of buying lamps in this manner. In one case a person offered a lamp, represented as being 60 C.P., which was bought and put up in place of one of 16 C.P. or thereabouts. The light given was certainly good, so good in fact that it was considered much too strong, and the lamp was ordered to be removed. This self-same lamp subsequently fell into the hands of the "boys," and was one day found in the lower part of the premises, where again it had superseded a lamp of much lower C.P. The firm grumbled at the amount of their electricity bill, but they have only themselves to blame, for the indiscriminate purchase of probably inefficient lamps, and a lavish use of light, will account for a lot of current. Then there is the danger from fire when high C.P. lamps are placed at points wired for much lower powers, if the fuses are not as sensitive as they should be; and if the fuses are all right there is the annoyance and inconvenience caused by their rupture.

American Belts for Russia.—"When the government and manufacturers in far away Russia send to America for leather belting, it is certainly an indication that the belts are good, and when a single order is cabled for 17,000 feet, it further shows that the Russians want a lot of a good thing." The *Western Electrician*, from whom we cull this paragraph, reproduces a cablegram received from Moscow by the Shultz Belting Company, St. Louis, on February 20th, which calls for 17,000 feet of Shultz belting, assorted sizes. In the same month an order was received from Sweden for 4,200 feet, assorted sizes. The foreign trade of this concern is very large, and includes also distributing depôts in London, Australia, Johannesburg, Africa, Brussels, Moscow, and Malmo, Sweden. There are also Shultz agencies in 20 of the leading cities of this country. The strictly high grade of the Shultz belts, their lasting qualities, and uniform standard of excellence, have made them justly famous in all parts of the world.

Kamm's Telegraphic Typewriter.—With reference to Mr. W. Gentry Bingham's letter which appeared in the "Correspondence" columns of our issue for April 17th, the matter in question really raises an important point to which attention ought to be drawn. The point is this—that inventors continually and seriously jeopardise the chances of their inventions turning out successfully by bringing out and publishing ideas which are only half matured. We were pressed, in the case in question, to give a description and to criticise the Kamm typewriter, and we did so, and we adhere to what we said. The apparatus, as we saw it, was not in a practical form, but we said nothing to suggest that it could not be made such; indeed, we said that "we should watch with interest the development of the same, and that Mr. Kamm was an expert mechanician," the meaning of which was obvious. Mr. Kamm expressed himself as able to effect this, that, and the other, improvements, and we do not doubt that he can do what he asserts; but, at the same time, to say that a thing can be done, and to actually do it, are two very different things. We prefer to see the thing actually done, and, we repeat, we do not express a doubt but that it can be done. We doubt somewhat the chances of success of the apparatus, not for mechanical, but for commercial reasons; mechanically the invention possesses distinct points of novelty, and we will, if Mr. Bingham desires it, "give it a further trial," but we strongly recommend that gentleman and Mr. Kamm to wait until the apparatus has had all the improvements made, so as to constitute it a perfect machine, before making further trials. We wish the invention every success, and it remains for those interested in it to make it a success, by going about the business in a right and rational way.

H. M. Salmony & Co.—A clerical error unfortunately occurs in the addresses of the above company in the "Universal Electrical Directory." That of the head offices and showrooms is given correctly as, 61, Charing Cross Road, London, W.C., but that of the fittings showrooms should have appeared as 36, Gerrard Street, instead of 36, Garrick Street, W.C. To obviate any inconvenience to the firm or its numerous customers, we are asked to call attention to the error.

Lighthouse Engineering.—At the Institution of Civil Engineers last week, a paper was read by Mr. N. G. Gedye on "Recent Developments in Lighthouse Engineering." The author said that, although the powers of electric lights may be increased to an even greater extent than at present, yet, after all, no light, electric, gas, or oil, is of any use in a fog when that fog has developed into anything denser than a mist.

The Southwark Boiler Explosion.—In their report upon the explosion of a boiler at the Southwark Electric Lighting Station, Bankside, Southwark, Mr. H. Smith, barrister, and Mr. J. H. Hallett, consulting engineer, the commissioners appointed by the Board of Trade, state that neither the City of London Electric Lighting Company nor any of their employés were to blame for the explosion.

Appointment.—Mr. Arthur Ellis, who was promoted to be electrical engineer to the Southport Corporation at a salary of £208 while the works were in progress, has been appointed electrical engineer at Bolton at £300 per annum.

Society of Arts.—On Monday, April 27th, at 8 p.m., the first of a series of four Cantor lectures, on "Applied Electro-Chemistry," will be delivered by James Swinburne. Lecture I.—Introductory.—Phenomena of Electrolysis.

Accidents Due to Gas.—On 17th inst., a serious gas explosion occurred at Kensington Road, Middlesbrough, doing considerable damage to the premises and furniture.

The Institution of Electrical Engineers.—On Thursday, April 30th, 1896, a paper will be read "On Railway Telegraphs, with Special Reference to Recent Improvements," by W. Langdon, Member.

More Honours for Röntgen.—It is stated that Prof. Röntgen has had the honorary citizenship of his native town, Lennep, in Rhenish Prussia, conferred on him, in honour of his discovery.

Australian Landline Again Interrupted.—From the Australian Press of March 13th, we gather that "Communication has been interrupted on the Port Darwin line, north of Powell's Creek, since 6 p.m. Parties will start inspecting at 6.30 a.m." It will be recollected that this is said to be the "most reliable" of the two trunk landlines on which our communication with Australia and New Zealand depends. It is to be hoped that at the approaching conference with Mr. Chamberlain, the insecurity of these trunk lines, as shown by the frequent interruptions, will be duly emphasised.

Lectures.—Before the Preston Scientific Society, on 9th inst., Mr. Tonge, of the National Electric Supply Company, lectured on "Electricity."

In the Ulster Hall Annexe, on 16th inst., Mr. John Brown lectured on the subject of "Horseless Carriages."

On 15th inst., Mr. W. B. Sayers read a paper on "The Domestic Applications of Electricity," before the Philosophical Society of Glasgow.

Personal.—Mr. W. J. Furse, J.P., electrical engineer, Nottingham, has been again unanimously elected Chairman of the West Bridgford Urban District Council.

We learn that Mr. T. Ahearn, of Ottawa, passed through London this week, on his way home after an extended holiday trip.

THE GREAT TRAMWAY SCHEME.

There has been a good deal said about the great tramway scheme for London, and the *Pall Mall Gazette* of Tuesday last gives the syndicate's official statement in detail. It may be said that the scheme shows great confidence in the County Council, which might or might not be justified. But before we say much about it, we will give the main proposals of the great syndicate:—

"1. That in the case of lines, or portions of lines, whose net earnings will provide interest and sinking fund on their cost according to the Bramwell award (whether acquired directly or indirectly from their owners), the County Council should lease the same to a company to be formed with an adequate capital, at a rental equivalent to the entire net earnings of such lines for the year preceding.

"2. That in the case of lines whose net earnings will not provide interest and sinking fund on their cost according to the Bramwell award which the County Council will acquire from the company at cost, the County Council should lease the same at a rental equivalent to the amount of interest and sinking fund on such cost.

"3. That the company should deposit with the County Council annually the estimated sum necessary to maintain and renew the lines leased.

"4. That the County Council should from time to time construct any new lines which it may see fit, and should lease the same to the company on the following basis:—The area of the county to be divided into zones one half-mile in width, the interior zone being based upon an imaginary line drawn from the Mansion House to Trafalgar Square, and forming a parallelogram one mile and three-quarters long by one mile wide. The exterior zones being successively defined at a distance of half a mile from such interior zone and the rentals of the lines included in such zones to be at the rate of £2,500 per mile per annum in the interior zone, and diminishing at the rate of £500 per mile per annum in each succeeding exterior zone, with a minimum of £500 per mile per annum.

"5. That the company should have the right to employ electrical traction on the underground conduit system on all lines subject to the approval of the County Council and the Board of Trade.

"6. That in the case of existing lines it should be agreed:—

"(*a*) That the entire cost of the reconstruction of the permanent way, and of the underground conduit, should be borne by the company, and that all such works should immediately on completion become the property of the County Council without consideration; and

"(*b*) That the entire cost of the equipment and plant for power should be borne by the company, but on the expiry of the lease the County Council should purchase such works at a valuation to be determined by arbitration.

"7. That in the case of new lines the County Council should construct the works in the public streets at its own expense, but that the cost of the requisite equipment and plant for power should be borne by the company."

The proposals are not simple, but we may take it that the syndicate propose to act as a kind of "buffer" company between the original or present owners of the tramway systems. It is assumed that if the County Council let out the working of the various lines, it will be infinitely more advantageous that the working should be in the hands of one company. Unquestionably there is a good deal in this argument. The main ground of the syndicate offer is undoubtedly based on the use of an underground electric conduit system. We have no knowledge of what the system is, or who are the promulgators of the scheme, although we hear it stated that Mr. Astor figures amongst them; but we do think that the case for electric traction has been more ably advocated than appears to have been done in the syndicate letter to the Council. Years ago a better case was made out for electricity. The arguments now set forth are decidedly commonplace

and not likely to convince an authority which showed so much unreasonable prejudice against the proposal to introduce the overhead system on the Uxbridge Road. One has lately heard a good deal about conduit systems, and we have seen some which, under experimental conditions, exhibit great excellence; but we should not at the present moment hail with enthusiasm any scheme that included a general adoption of an electric conduit system for London. We are quite willing to admit that the future system may be a conduit one, and may be it has been invented, but it is at any rate not generally known.

But apart from electrical considerations, it is not very likely that the County Council will fall in with the scheme. The *City Press*, of Wednesday, says:—"We understand that the Highways Committee of the County Council will bring up an important report on the tramways question either next Tuesday or on the following Tuesday. The offers of the syndicate have not been entertained, but the Committee will report that the North Metropolitan and the London Street Tramways have jointly agreed to sell their undertakings to the Council at once, and to pay a sum of £600,000 for the 14 years lease to be granted to them. This will be equivalent to 9 per cent. on the capital outlay. The Committee have also completed negotiations for leasing other tramways, which will return 5 per cent. on the capital outlay."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Telegraph Construction and Maintenance Company, Limited (11,470).—The annual return of this company was filed on March 26th. The whole capital of £448,200, in £12 shares, has been taken up, and paid for in full.

Notting Hill Electric Lighting Company, Limited (25,921).—This company's annual return was filed on March 17th. The capital is £100,000, in £10 shares (6,452 ordinary, 550 founders', and 2,998 preference). All the ordinary and founders, and 1,860 of the preference have been taken up, the full amount has been called, and £88,620 has been paid.

Charing Cross and Strand Electricity Supply Company, Limited (29,122).—This company's annual return was filed on March 14th. The capital is £250,000 in £5 shares; 30,000 of these have been taken up, and £150,000 paid.

City of London Electric Lighting Company, Limited (34,406).—This company's annual return was filed on March 16th. The whole capital of £800,000, in £10 shares (of which 40,000 are preference) has been taken up, and the full amount called and paid.

Chelsea Electricity Company, Limited (20,468).—This company's annual return was filed on March 28th. The capital of £100,500 in 14,000 ordinary and 6,000 preference shares of £5 each, and £500 founders' shares of £1 each, has all been taken up. 6,666 ordinary and 500 founders' shares are considered as paid. The full amount has been called on the rest, and £66,670 has been paid.

Peru Telephone Company, Limited (29,290).—This company's annual return was filed on January 20th. Seven shares have been taken up out of a capital of £100,000 in £5 shares, and no calls have as yet been made.

Oxford Electric Company, Limited (34,685).—This company's annual return was filed on March 26th. 6,586 shares have been taken up out of a capital of £100,000 in £5 shares, and £32,930 has been paid.

Queen Anne's Mansions Lighting and Heating Company Limited (34,272).—This company's annual return has just been filed. The whole capital of £60,000 in £10 shares (of which 3,000 are preference) has been taken up, and issued as fully paid.

Hove Electric Lighting Company, Limited (36,942).—This company's annual return was filed on March 25th. The capital is £40,000 in £5 shares; 6,633 shares have been taken up, and £5 per share has been called on 6,221, and £2 per share on the others. £32,025 has been paid, and £250 10s. remains unpaid. £346 10s. has been paid in advance.

Rugby School Electric Lighting Company, Limited (39,309).—This company's annual return was filed on March 9th. 70 shares have been taken up out of a capital of £5,500, in £50 shares, and £45 per share has been called. £3,130 has been paid, and £20 remains in arrears.

CITY NOTES.

Norwich Electricity Company, Limited.

The annual meeting of this company was held on 15th inst., at the office, Queen Street, Norwich, Mr. F. W. Harmer in the chair. There was a good attendance of shareholders, to whom the following report of the directors, with accounts appended, was presented:—

In presenting their fourth annual report, the directors have much pleasure in stating that the success realised during the first fifteen months of the company's working has been fully maintained during the past year. The demand for current, both for lighting and motive power, has continued to increase in a most satisfactory manner, the number of customers being now considerably in excess of that of 1894. A large number of private houses have been wired, and the directors think that at length the public are beginning to appreciate the enormous advantages of electricity as compared with any other method of lighting. During the year, upwards of two miles of new mains have been laid, making the total length about seven miles. A new engine and dynamo of 200 horse-power have been added to the generating plant. A new battery sub-station has been erected in Eagle Street, Newmarket Road, which will enable the company better to maintain the pressure at the time of maximum load, and to supply current to an important residential district. In order to obtain a day load for their machinery, which would otherwise be standing idle, the directors have reduced the price for motors which are run continuously during the day to 3d. per unit at all hours. This they believe will result in an increased and profitable revenue from boot and shoe manufacturers and others requiring motive power. Since the last general meeting 4 per cent. debentures to the amount of £19,500 have been issued, for the purpose of paying off the loan from Messrs. Gurney & Co., and to provide for the increased outlay for machinery, mains, &c. The revenue account for the year shows a credit balance of £2,847 3s. 1d., to which must be added £112 5s. 8d. brought forward from last year, making a total of £2,959 8s. 9d. From this must be deducted £749 3s. 5d. for interest on debentures, &c., leaving a balance of £2,210 5s. 4d. With this the directors propose to declare a dividend of 3½ per cent., free of income-tax, amounting to £991 12s. 10d., to place £1,100 to depreciation account, and to carry forward the balance to next year. The directors who retire this year are Mr. Chamberlin and Mr. Coaks, and they offer themselves for re-election. Mr. Mottram, the auditor, retires, but is eligible for re-election.

The Chairman said if the shareholders compared this year's report with that issued 12 months ago, they would find it to be most satisfactory. The income had increased £2,000, that was to say, from £3,786 in 1894, to £5,845 in 1895, and this at a much smaller expense, for while coal cost £994 in the former year, it was only £1,300 in the latter, and in salaries the increase had been in the same proportion. Of course, the expense to which they were put was not for coal, but for interest on capital. That increased fast, and he was afraid it was likely to do so. The outlook for 1896 was most promising. His anxiety was not to get fresh customers, but to be able to get the machinery to supply them. At present the makers were exceedingly busy, but they had an order from the directors for machinery to be delivered next winter. He had no doubt they would be able to get through safely, but he was not at all anxious to get a larger number of customers, though without question this company would grow to be a big thing in the end. They were gradually extending their boundaries in all directions. They were creeping down Bracondale, they had made a long stride down Newmarket Road, they had gone along Thorpe Road, and they had other projects in hand which would no doubt be profitable, and give them abundant work for the next year. And it gave him pleasure to state that they would be able to carry on this business at a profit. He believed they had a right system, the right machinery, and the right men to work it. Very much credit was due to the staff. It spoke well for them that since the company started, nearly three years ago, the machines had been charged the whole of the time—not for a single moment, night or day, had the current ceased—while they had passed the year without an accident of any kind, and he believed they might look forward to such exemption in future. Very great care was taken with the works and system. But with care he did not think there was much danger, especially with the low tension system adopted, which he had no doubt was the right system. Certainly it was more profitable to work, and was much safer than the high tension system, and, as he was informed, the machines used were more permanent. As to the financial position. At that time last year they were £15,000 in debt, with over £10,000 expenditure before them; but the directors had such confidence in the company and its prospects, that instead of borrowing money at the rate they would have had to pay, they obtained it on their responsibility, without applying to the public to take up shares until they felt they could show the enterprise was going to be a success. Some of the best London companies had to issue debentures at 6 per cent. and preference shares at 7 per cent., but this company waited until they could show the public that this concern was going to be a success. Then they proposed to issue 4 per cent. debenture shares that were taken up readily. They could have had taken up any quantity, and at that moment any quantity of money they were likely to want was lying in view. That was due to the character of the men by whom he was surrounded, and in whom the public had confidence, for the directors were men of standing and position. As to the establishment of a sub-station on the Newmarket Road, that was put down principally in view of the proposal to introduce the electric light at the hospital, which had just been done by the unanimous vote of the board of management. He never had any doubt but that the light would eventually be adopted at the hospital. One thing very satisfactory about it was, that the board of management were very careful, for they first tried the incandescent light, about which they had heard a great deal, but which had never in the least interfered with the progress of this company. This turned out to be thoroughly unsatisfactory, and the board of management had come back to the suggestion to have the electric light. With the new station on Newmarket Road the directors would have no difficulty in supplying the hospital and also a number of residences, many of which beyond the hospital had already taken it. No doubt the company would gradually creep into the other suburbs in the same way. Repeated applications for the light had been made from people in the suburbs, and in time they would be able to supply the demand. But it was far better to occupy the nearer territory, which was most profitable, for the map showed that in the principal parts of the city

they had almost driven out the gas. In the Market Place and London Street there were few shops which contained the old-fashioned system of lighting by gas. At the end of 1894 this company had 297 customers, and at the end of 1895 they had 450. At the end of 1894 the number of lamps wired, or their equivalent, was 6,800, and at the end of 1895 it was 9,980. The demand by new customers was going on, for there were then more applications than at the corresponding period of last year.

Mr. H. S. Patteson seconded.

The report and accounts were adopted. The retiring directors and auditor having been re-elected, votes of thanks concluded the meeting.

Eastern Extension, Australasia, and China Telegraph Company, Limited.

The gross receipts, including Government subsidies, have amounted during the half-year to December 31st to £311,582 10s. 11d., against £261,322 14s. 6d. for the corresponding period of 1894. This large increase, the directors state, is mainly due to the exceptionally heavy traffic transmitted to and from Western Australia in connection with the gold mining industry that has recently sprung up in that colony. The working and other expenses, including £20,713 2s. for cost of repairs to cables and expenses of ships, absorb £84,044 6s. 4d., against £89,740 14s. 9d. for the corresponding period of 1894, leaving a balance of £227,538 4s. 7d. From this is deducted £4,318 8s. 4d. for income-tax, £20,000 transferred to the fire insurance fund, £31,895 for interest on debentures, debenture stock, and contribution to sinking fund, leaving as the net profit for the half-year £171,324 16s. 3d., which, with £70,504 13s. 3d. brought forward from the previous half-year, shows an available balance of £241,829 9s. 6d. One quarterly interim dividend of 1¼ per cent. has been paid for the half-year, and it is now proposed to distribute another of like amount on the 30th inst., making, with the interim dividends paid for the first half-year, a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year 1895. The balance of £129,329 9s. 6d. has been carried to the general reserve fund, which now stands at £561,546 9s. 9d.

Elmore's German and Austro-Hungarian Metal Company, Limited.

The report for 1895, to be laid before the fifth annual ordinary general meeting to take place in London on Monday, states the accounts are submitted in conjunction with those of the "Metall" Company, and show that an important reduction has been made in the capital—the whole of the £25,980 second debenture stock has been redeemed, and 10,337 ordinary shares have been handed by the holders for cancellation as a donation to the company or order to improve its position. The benefit to both preference and ordinary shareholders by this reduction is apparent, as it has enabled the directors to write off the deficit standing to the debit of the company, and to reduce the value of amount standing to patent account by £1,441. The amount due to this company from the "Metall" Company is now £19,008. The two mortgages which are held as security are now in the hands of Lord Farrer of Abinger and Mr. J. R. Holland, as trustees for the debenture-holders. The directors have agreed to waive one-half of their fees for the past year. With regard to the "Metall" Company's accounts, the capital has been reduced to 600,000 marks, or £30,000, in order that the loss standing to the debit of profit and loss should be written off; also that £2,512 has been spent in new plant. With regard to the trading account, the directors think that, considering the severe frost in the early part of the year and the almost unprecedented drought, which much retarded the business of manufacture, the progress made is very satisfactory. The sales are more than double those of 1894, and a comparison with the trading account for that year will show that, notwithstanding this, and the fact that the stock-in-hand has increased by £2,200, the manufacturing purchases (excluding copper), wages, &c., have increased only in a very small proportion. The transfer of a loss in 1894 of £9 to a profit of £3,654 is satisfactory. Attention is drawn to the important reduction in the charges in the profit and loss account as compared with 1894, and the directors are considering the means of still further reducing them. The directors regret that a loss of £1,575 is shown upon the year's working, but they desire to point out that this has been brought about by the large sum of £2,554 written off as depreciation on the various assets. An arrangement has, however, been made whereby in the future only such sum as actually represents fair wear and tear shall be written off. With regard to the work generally at the factory, the directors are pleased to report that the goods produced are giving the utmost satisfaction; this is evidenced by the large numbers of orders that are received week by week. The average selling price has been good, being nearly £5 per ton higher than in 1894. The experience gained at the factory shows that to produce the highest quality copper it is advisable to work at a slower rate of deposit than was at first adopted, therefore the plant erected does not produce the amount that was anticipated, and it is of importance that the number of tanks be increased. This can be done at a comparatively small cost, and it is proposed to put down 16 additional large tanks at an early date. It is necessary to issue a further amount of debenture stock to pay for the new plant, the additional copper required, and to pay off the overdraft at the German bankers, which is guaranteed by two of the directors and two shareholders. The directors consider that the business warrants the expenditure, and they are assured by the works' manager that more than sufficient orders will be offered to keep the new plant at full work.

The Oriental Telephone and Electric Company, Limited.

At the second ordinary general meeting of this company, held at Cannon Street Hotel on Wednesday, Mr. Wm. Addison, who presided, congratulated the shareholders on the progress of the company, and especially on the declaration of a 5 per cent. dividend. With reference to the loss of the Colombo exchange, the board had been throughout the year in continuous negotiation with the Government of Ceylon, which had given notice that the license, which was to expire in December, 1895, would not be renewed. With all respect due to a Government, he was bound to say that the company had been treated in a manner very discouraging to private enterprise, and unfair to a company which had invested a considerable sum of money in the colony, and was ready to invest still more freely, if it could have obtained continued security from the Government. The directors had not received that measure of support from the Colonial Office which, under the circumstances, they were entitled to ask. In the end the board had to accept a sum which represented only a small part of the value of the exchange upon which had been spent in cash, about £4,086 odd, to which must be added goodwill, and compensation for forcible possession. After a few further comments the chairman moved the adoption of the report and accounts.

This having been seconded, was carried unanimously, after remarks had been made by shareholders, and the retiring directors and auditors re-elected, the proceedings closed with the usual vote of thanks.

Hastings and St. Leonard's Electric Light Company, Limited.

The accounts of this company show an increase of income from public and private lighting of £1,271 for the year, but it has been found necessary to debit the year's accounts with the loss sustained on the sale of installation stock, and also the bad and doubtful debts in connection with the late installation business. The directors have still, however, great confidence in the stability of the company, and believe that with careful management, and a strict control on the expenditure, good results will be shown on the next year's working, and with that view they have written off every loss they are aware of. The directors have (with a view of increasing the income of the business) for some time supplied the light all day, and they hope it may be possible to continue such supply, it having been greatly appreciated by numerous customers, but it must depend entirely on the consumption whether it can be made remunerative. The arc lighting of the sea front has, unfortunately, not proved remunerative, and if such contract is renewed in June, 1897, it must be on terms more favourable to the company. Messrs. F. J. Parsons and F. Noakes retire from the directorate by rotation, but they are eligible, and offer themselves for re-election. The auditors, Messrs. Hart Brothers, Tibbetts & Co., also retire, and offer themselves for re-election.

The Great Northern Telegraph Company, of Copenhagen.—The receipts during 1895, including the balance brought forward from 1894, amount to £413,871 6s. 11d., to which is added interest £28,124 odd, and sundries £23,242 odd, making gross receipts £465,238 odd. The total expenses amounted to £83,655. Payments made for interest on, and amortisation of debentures amount to £85,916 odd. The board propose to distribute the balance as follows:—Interim dividends already paid, £75,000; final dividend proposed (10s. per £10 share), £75,000; reserve and renewal fund, £83,333 6s. 8d.; pension fund of the staff, £2,777 15s. 7d.; remuneration to the board of directors, £1,500; balance carried forward, £58,055 7s. 1d.

Metropolitan Electric Supply Company—Correction.—In our report of this company's meeting in our issue of April 3rd, we stated that the chairman, replying to shareholders, said that "they had a class of *machines* which cost very little, but the coal consumption of which was very heavy, while other companies had paid more for their *machines*, and the coal consumption was less." We are told that the words *machines*, in both cases, should read *mains*.

The Eastern Telegraph Company, Limited.—This company announces the payment by warrants, on May 1st, of interest for the half-year ending April 30th on the 4 per cent. mortgage debenture stock. The transfer books will be closed from April 27th to May 1st, both days inclusive.

The Eastern and South African Telegraph Company, Limited.—This company announces the payment by warrants on May 1st of interest on their 4 per cent. Mauritius subsidy debentures for six months to April 30th, 1896. The transfer books will be closed from April 27th to May 1st, both days inclusive.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending April 19th, 1896, were £921; week ending April 21st, 1895, £856; increase £65; total receipts for half-year, 1896, £15,260; corresponding period, 1895, £15,218; increase, £42.

The Liverpool Overhead Railway Company. The receipts for the week ending April 19th, 1896, amounted to £1,151; corresponding week last year, £1,386 decrease, £235.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 17th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,668.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, April 15th.	Closing Quotation April 22nd.	Business done during week ended April 22nd, 1896. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	10½— 11	10½— 11	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	49 — 51	49 — 51	51	49½
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	92 — 93	92 — 93	93½	92½
2,993,560£	Do. do. Defd.	Stock	...	...	...	10½— 10¾	9½— 10	10 11/16	9⅝
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	...	14¼— 14¾	14¼— 14¾	14⅝	14½
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	...	1/16— 3/16	1/16— 1/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½— 13½	12½— 13½	13	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½— 21½	20½— 21½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	106 —109 %	106 —109 %	...	...
60,710	Direct United States Cable, Ltd.	20	2⅝% §	2 %	...	9½— 10	9½— 10 xd	9⅞	9⅝
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	...	17 — 17½	17 — 17½xd	17⅝	17½
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18 — 18½	18 — 18½xd	18½	18
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	106 —109	106 —109	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	130 —133	130 —133	132⅝	130⅜
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17¾— 18¼	17¾— 18¼	18¼	18
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	101 —105	101 —105	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	102 —105	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	128 —131	129 —132	132	130½
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	103	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	105 —108	105 —108	105½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	112 —115 %	112 —115%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅝% §	4½%	...	10½— 11	10½— 11	10⅝	10½
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	...	16¾— 17¼	16⅝— 17¼	17⅝	16⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	8⅝%	10 %	23 — 23½	23 — 23½	23 1/16	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	49 — 52	53 — 56	54¼	52
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	108 —111	108 —111	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	6⅞— 7⅛	7 — 7¼	7⅛	7
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	18	17
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16½— 17½	16½— 17½	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅜— 6⅞	6⅜— 6⅞	6⅜	6⅜
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	106 —109	106 —109	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	5 %	9/16— 11/16	9/16— 11/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 —111	108 — 111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	...	5 — 6	5 — 6	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138	133 —138	136	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	3½— 4	3½— 4	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	96 —101	96 —101	99	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	...	5½— 6½	5½— 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	102 —105	102 —105	104½	103
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	95 — 100	97 —102	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	...	8½— 9	8½— 9	9	8 13/16
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6½— 6¾	6½— 6⅝	6 7/16	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	...	2½— 2⅝	2½— 2⅝	2⅝	...
165,200£	Do. do. do. 6% Debs. "A," 1880 Red.	100	6 %	6 %	...	104 —108	104 —108	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	104 —108	104 —108	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	⅛%	...	1 — 1½	1 — 1½	1 1/16	1 1/16
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	11 — 11½	11½— 11⅝	11¼	11 5/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9½— 10½	9½— 10½	10	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	113 —118	113 —118	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	102 —103	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	7½— 7⅝	7½— 7⅝	7 9/16	7½
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7½— 8	7½— 8	7 13/16	7⅞
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	116 —119	116 —119	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14½— 15½	14 — 15	14 15/16	14 11/16
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	16½— 17	17	16 9/16
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	134 —138	134 —138	135½	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	*nil*	8 — 9	8 — 9	...	...
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	6 %	12½— 13½xd	12½— 13½	12⅞	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5½%	6 %	7⅞— 7⅞	7⅞ — 7⅞	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	2½%	3 %	...	12½— 13	13 — 14 xd	13 1/16	13⅛
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	118 —120	118 —120	120	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	8¾— 9½	9 — 9½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	10 — 10½	10½— 10⅝	10⅝	10½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9⅜— 10½	10 — 11	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	9¾— 10¼	9⅝— 10¼	10⅛	9 13/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, April 15th.	Closing Quotation. April 22nd.	Business done during week ended April 22nd, 1896. Highest.	Lowest
£0,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	5 % §	2½%	...	1¼— 1⅜	1¼— 1⅜	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1⅜— 1½	1⅜— 1⅝	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
630,000*l*	City and South London Railway	Stock	1 1/16%	1 1/16%	1 1/16%	40 — 42	40 — 42	41¼	40¼
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	...	2¼— 2⅜	2¼— 2⅜	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	...	1½— 1⅝	1½— 1⅝	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	...	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	1⅛— 1⅜	1⅛— 1⅜	1 5/16	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2½— 2⅝	2½— 2⅝	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅝— ¾	⅝— ¾	...	..
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅝— ¾	⅝— ¾	...	..
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil*	...	¼— ⅜	¼— ⅜	.	.
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	...	9½— 10½	9½— 10½	...	..
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	16½— 17½	16½— 17½	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	16½ — 17½	16½— 17½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	107 —112	107 —112		...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	20½ — 21½	22 — 23	21½	20⅝
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	... ...	... ...	...	.
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅝%	14 — 14½	14 — 14¼	14 3/16	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅝ — 16⅞	16⅝ — 16⅝		.
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	38 — 41	38 — 41	40	38¾
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ..	10	...	.	...	8¼— 8⅜	8¼— 8⅜	8⅜	8¼

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½%; 1890—½%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾—6¼.

Electric Construction Corporation, 6 % Debentures, 102—105.

House-to-House Company (£5 paid), 3⅛—3⅜.

Do. do. 7 % Preference, of £5, 8⅛—8⅜.

Do. do. 4½% Debentures of £100, 109—111.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 8¼—8⅜; 1st Preference Cumulative 6 %, £5 (fully paid), 7¼—7⅜.

Liverpool Electric Supply, £5 (fully paid), 7¾—8¼.

London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7—7½.

Bank rate of discount 2 per cent. (February 22nd, 1894).

REVIEW.

The Magnetic Circuit in Theory and Practice. By Dr. H. Du Bois. Translated by Dr. Atkinson. London: Longmans, Green & Co.

The title of this work is misleading. Strictly speaking, it is only the second portion of the book that deals with the magnetic circuit. In the first five chapters forming Part I., the author gives a general *resumé* of the mathematical theory of magnetism as developed by Maxwell, and the essential idea of the magnetic circuit, viz., *the continuity of magnetic flux* in an electro-magnetic system, is to a great extent lost sight of. Throughout the book Dr. du Bois employs German capitals, H, I, B, to denote those quantities, the vector character of which is to be clearly shown. We consider that the work would have been rendered more palatable to English readers if the translator had followed the example of Prof. Ewing, and had adopted the use of block capitals in the English edition.

In the opening chapter we are introduced to the usual complication of magnetic terms, such as intensity of magnetic field denoted by H, induction denoted by B, and magnetisation denoted by I. As the dimensions of permeability are not expressed, all these three quantities have the same dimensions, viz., $[L^{-\frac{1}{2}} M^{\frac{1}{2}} T^{-1}]$. It may be pointed out that a misprint occurs in the table headed Nomenclature, at the end of the book, where the dimensions of three different varieties of magnetisation are given as $[L^{-\frac{1}{2}} M^{-\frac{1}{2}} T^{-1}]$. As a natural result of the vectors above mentioned, we have the scalars, permeability, susceptibility, and reluctivity. We may here point out how much complexity in notation and symbols might be avoided by discarding the term *magnetisation* altogether, and making use only of the term *induction*.

Induction and magnetisation express exactly the same idea, viz., the density of the magnetic flux. In ordinary circumstances the author tells us that we may, with close approximation, put $B = 4\pi I$. This dual system of measuring flux density is like a bimetallic system of currency. Magnetisation may be compared with gold coinage measured in sovereigns, and induction with a silver coinage measured in francs. The units in which magnetisation and induction are measured by the author are C.G.S. units, but the C.G.S. unit of magnetisation is 12·57 times as great as the C.G.S. unit of induction, althongh both units have the same name. The reader has, therefore, to carry in his mind two different units for the measurement of what is practically the same quantity. If the terms induction and permeability were retained, and magnetisation and susceptibility were relegated to the limbo of obsolete scientific terms, a great simplification would at once be made in the theory of magnetism. The author states that "the induction, B, was long regarded, particularly by some English authors, as the more fundamental principle. Herein there has, however, already been a change of opinion, and now, as at first, the magnetisation is considered as the physically more important conception in dealing with purely scientific questions." Our own opinion is that, important as the induction is, the tendency of modern thought, especially from the practical point of view, is to regard the *quantity of magnetic flux* as the most important conception in the theory of magnetism.

In the second chapter the author deals with the special case of an incomplete iron circuit, and calls attention to the reduction in the magnetisation which results when a complete iron circuit is interrupted by an air gap. The explanation given of this result, is that the magnet, which was endless when in the form of an iron ring, now has two ends. "Owing to the action of the ends, a magnetic field is now formed in the surrounding space." . . . . "Both ends, therefore, exert a demagnetising action on the bar, the intensity of which we will call H_i." In other words, the leakage magnetic flux, which is merely a phenomenon resulting from the interruption of the hitherto complete iron circuit,

is regarded by the author as the cause of the reduction in the magnetisation. If, however, we regard this example from the point of view of the magnetic circuit, the explanation is simple. It must be borne in mind that the magnetic flux is continuous, both in the original iron ring, and also in the ring when it is divided and straightened out. In the latter case, however, the circuit of the flux is completed through the air along paths, which have a much greater reluctance than that of the original iron ring. The consequence is that, if the excitation is the same in both cases, the magnetic flux, which has to pass through air as well as iron, is much less than that which has to pass through iron alone.

The next two chapters deal with the theory of rigid magnets and of magnetic induction. Trilinear coordinates are freely employed in these pages, rendering them unsuitable for any except advanced mathematical students.

Chapter V. is devoted to the consideration of closed and radially divided toroids, and contains an account of some experiments made by Dr. Lehmann to test the author's theory. A series of tests were made to determine the leakage coefficient of an incomplete ring of iron with several different air gaps. It was found that the coefficient for each particular width of gap was sensibly constant for low values of magnetisation; but that when the magnetising force was increased, and the permeability of the iron began to decrease rapidly, the coefficient decreased. As the permeability of the core decreases, saturation begins at its centre and extends gradually to the two ends, thus decreasing the leakage surface. The consequence is that the proportion of the leakage flux to the total flux decreases also.

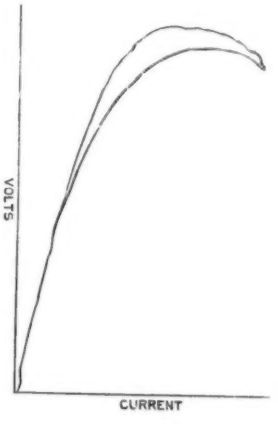
Turning to Part II. of this volume, which is headed "Applications," we find a very complete history of the development of the modern theory of the magnetic circuit, and the reader will not fail to remark how very widely in this case practice differs from the theory as described in Part I. The Hopkinson method of treating the magnetic circuit is described at length, and experiments of Wassmuth, Bidwell, and Bosanquet on Maxwell's law of magnetic traction are also described. In Chapter VII., after tracing the part taken in the development of the theory of the magnetic circuit by Faraday, Maxwell, Lord Kelvin, Rowland, Bosanquet, and others, Dr. du Bois states the law of the magnetic circuit as follows: "The flux of induction is equal to the magnetomotive force divided by the reluctance," and proceeds to compare it with Ohm's law. One essential difference between the magnetic law and Ohm's law is that the electrical resistance of a conductor is constant, as long as the temperature remains the same, no matter what may be the current density in the conductor, whereas in the case of an iron magnetic circuit the reluctance, which is analogous to electrical resistance, is not constant, but varies very greatly with an increase or diminution of the induction of the iron. This is pointed out by the author, but he does not notice a second, and perhaps more important distinction between the electric and magnetic circuits, which is that in the case of the electric current there is a dissipation of energy equal to $C^2 R$, while in the case of magnetic flux there is no such dissipation of energy. The main point of resemblance between the two circuits has also been overlooked. What we call an electric current must always have a complete closed circuit. We cannot detach a finite length of conductor conveying a current from its circuit. If this were done the circuit would be interrupted, and the current would stop. The current flows continuously in all parts of the circuit. Similarly in the case of magnetism, the magnetic flux is continuous in all parts of the circuit, which must be carried completely round in a closed path to the starting point. It is, however, much more difficult to canalise magnetic flux than electric current, and we generally have in the case of a magnetic circuit a much greater amount of leakage than in the case of an electric current. This fact, as well as the variation of the permeability in ferro-magnetic bodies, renders the practical application of the law of the magnetic circuit much more difficult than that of Ohm's law to an electric current. It may be observed that the law of an air core magnet is the exact counterpart of Ohm's law, as the reluctance is constant.

Chapter VIII. deals with the magnetic circuit of dynamos and electromotors, and special attention is given to the work of Drs. J. and E. Hopkinson. The essential parts of dynamos are described, and examples of different types of magnetic circuits are given. In the remaining chapters will be found a considerable amount of information of a varied kind on hysteresis, electro-magnets, transformers, and magnetic measurements. In foot notes throughout the book reference is made to the work of various writers and experimenters, whose names are collected in a complete alphabetical list at the end of the volume. There is also an index of subject matter. The book may accordingly be recommended as a valuable and comprehensive work on magnetism suitable for advanced students.

A REASON FOR THE FAILURE OF ELECTRO-MAGNETIC REGULATORS.

Both arc and incandescent machines are often regulated in potential by electro-magnetic devices which vary the field strength, and it is often found that after having been carefully adjusted they will refuse to regulate properly after a few hours under adjustments that at first were most successful. This is often attributed to the differences in temperature of the machine, and this would be a most sufficient reason if the difficulty did not continue after a constant temperature had been attained. When the current or potential of a machine has a certain value, the electro-magnetic device will make a certain adjustment of the exciting current, and this adjustment may or may not be right, even though the output conditions and the temperature of the machine be exactly the same as that of a few hours before, when the adjustment exactly corrected the value of the current or voltage.

The reason for this is found, says the New York *Electrical World*, in the hysteresis of the field magnets. As the load comes on in either arc or incandescent machines the field strength rises, and the magnets at a certain output require a certain magnetising power. On descending the load curve the magnets give a denser flux with the same value of exciting current, and hence an entirely different



set of field adjustments are needed. No automatic regulator which depends upon the output of the machine can accomplish this. The point is well illustrated by the characteristic curve of a machine. If the curve of a series machine be taken up to the current capacity of the machine, and then a descending set of readings made, a curve similar to the fig. will result. Being a series machine, the difference in voltages that may exist with the same field current can be readily appreciated.

There are not a few designers who ascribe to slight temperature changes the failure of their compound machines to regulate exactly, but the many cases where the voltage of a compound machine remains *higher* than it should on descending load cannot be so explained. Therefore, in testing machines, particularly those having magnet cores of a new grade of iron, it is important to take both ascending and descending characteristics. The divergence of the two curves will afford information as to the inaccuracy of regulation that hysteresis will incur, and it will often be found to be a factor of sufficient moment to notably influence the choice of iron for field-magnet purposes.

A CONDITION NECESSARY FOR OBTAINING BRIGHT SHADOWS BY MEANS OF RÖNTGEN'S RAYS AND A PHENOMENON WHICH AFFORDS THE METHOD OF ITS REALISATION.*

By PROF. E. SALVIONI.

It is, perhaps, not useless to call the attention, especially of practical men, to a condition indispensable for obtaining clear shadows with the Röntgen rays upon fluorescent screens, and hence upon photographic plates, of objects surrounded with a wrapping of a certain magnitude.

It is a quite elementary notion of geometrical objects, that when the illuminating source has a certain extension with regard to the distance from it of the objects upon which the light is projected, the shadows do not come out clear, because they are accompanied with a penumbra; and that for ordinary light, the conditions for attaining distinct shadows is to reduce the illuminating sources as far as possible to luminous points. This same condition ought to hold good for the agency of Röntgen (whether it is light or not), since it propagates itself in right lines. Instead, it has been attempted even in photographic reproductions, for which a great intensity is not required, to have the efficient surface of the Crookes tubes very extensive; this is proved also by the form now given to the Crookes tubes supplied in commerce for reproducing Röntgen's phenomenon in which the part rendered efficacious under the action of the cathodic rays is the wider part (not less than 30 square centimetres). This involves the necessity of holding the objects of which it is desired to obtain the shadows on photographic plates or on fluorescent screens, very close to the plates or screens; this is not possible precisely in the most interesting case of the practical applications, then the objects are enclosed in coatings of a certain size. This happens if we limit ourselves to common instances, when it is wished to obtain the shadow of the bones of the wrist or the arm. To this circumstance I ascribe the generally unhappy result of the experiments with fluorescent pasteboards, experiments which form the fundamental part of the discovery of Röntgen. Given the necessity of such conditions, let us see how they may be reached.

It is a fact well established by the experiments of Röntgen and the studies of Batelli and Gabasoc (*Nuove Cimento Ser.* IV., Vol. III., *Fasc.* 1) that in ordinary Crookes tubes the X rays emanate from the region of the tube where the cathodic rays excite fluorescence. A method of carrying the origin of the X rays to whatever part it is desired to have them consists in the use of magnets suitably arranged, since it is notorious that magnets deflect the cathodic rays. This means, first used, I believe, by Lommel, serves well to convey the fluorescent region wherever it is desired, and which is very useful in practice from the well-known circumstance that for some time the capacity of fluorescence has been exhausted. In fact, on prolonged use there comes to be formed in the fluorescent region a black spot from which effective rays no more issue. The use of magnets serves better to reassemble the cathodic rays in a restricted region of the wall of the tube, if we have at disposal Crookes tubes with a cathode formed with a spherical cap. The cathodic rays which, as it is known, issue normally from the surface of the cathode, meet each other at a point (the centre of the sphere) generally within the tube. Then the poles of the magnet approach each other very conveniently, since which ever point of meeting is thrown upon the side wall of the tube gives rise to a very restricted fluorescent zone generally elongated in the direction of the tube. In order to obtain under such conditions distinct shadows it is sufficient to take care to dispose the objects along the tube in the direction of its length.

But without having recourse to magnets, here is a very simple and convenient method to obtain the same object with results rather better if we have at our disposal tubes with cathodes made with a spherical cap. This single expedient, to which I had recourse in my first experiment, was suggested to me by chance. It occurred to me at the outset that if any one touched the tube with the hand the luminous aspect of the tube varied in an extraordinary manner. On stroking the tube with a finger from the cathode towards the anode, the tube at first loses all fluorescence, then the fluorescence resumes until reaching a maximum of a very striking character. On continuing to move the finger the fluorescence reappears at the anode. On more closely examining the phenomenon it is observed:

1. That in place of the hand in communication with the earth, we may as well use a strip of tin (the narrower the better) in communication with the cathode.

2. In place of the tin it is sufficient to bring in contact with the tube a simple metal point in communication with the earth or with the cathode.

In this last case which I have adopted in practice, a very intense fluorescence limited to a surface not more than 1 square centimetre appears immediately when the metal point touches any point whatever of a determinate section of the tube, and exactly at the same time it is excited at the point opposite to that which has been touched. The sensitive section of the tube, where should be placed the point where the phenomenon is most conspicuous, is found at a distance from the cathode almost equal to the radius of the curvature of such cathode. The phenomenon is explained by assuming that the tube where is formed the effective zone is positively electrified, and that the rays capable of exciting fluorescence and Röntgen's accompanying phenomenon collected in one point within the spherical cathode are attracted towards one part of the tube when the opposite part is discharged at the point communicating with the earth or with the cathode. This phenomenon may be placed in relation with the idea communicated on another occasion relative to the nature of the Röntgen rays. In accordance with this idea it is a question of matter projected from the tube which will be positively electrified; a circumstance that qualitatively agrees with the new facts discovered by Righi.

Turning now to the practical side, it is evident that the condition of having on the tube a restricted region strongly effective so as to obtain clear shadows may be easily obtained by applying the artifice above mentioned.

At the next meeting I will communicate the results of some attempts made to determine the speed of propagation of Röntgen's rays.

(Extract from the *Transactions of the Medico-Surgical Academy of Perugia.*)

* Communicated to the Medico-Surgical Academy of Perugia in the Session of February 22nd, 1896.

COMPARATIVE TESTS OF SMOKE PREVENTING APPARATUS.

The Chicago Edison Company has been experimenting with the Hawley down-draught furnace, which has been already described by us, and the *Electrical Engineer* (America) now publishes some tests made in comparison with another furnace. Of these two furnaces the Hawley has a double grate, the upper one being the down-draught grate of water tube bars, and the lower one merely a surface to catch the half burned stuff falling through the upper grate. The McKenzie furnace operates by masses of fire-brick placed beyond the bridge walls of an ordinary furnace; it is, in fact, one of the many furnaces utilising the principle of regeneration. Both furnaces were applied to Heine boilers of the same size with only a slight difference in the number of tubes, the McKenzie furnace having about 14 per cent. more heating furnace, though the Hawley water grate might fairly be assumed as adding to the heating surface of the boiler, though it is not allowed in estimating the horse-power. The dampers were regulated so as to give an equal water gauge in each boiler.

Other general precautions were observed. The smoke record was kept by means of instantaneous photographs every 15 minutes, and, as regards these, the plume must be awarded to the McKenzie furnace most undoubtedly. For the economy tests at a combustion of 31 lbs. of coal per square foot of grate, however, the Hawley furnace showed the better evaporation by 3·16 per cent., or 3·71 per cent. from and at 212°. It showed 10 H.P. less capacity, but 10 per cent. greater proportion of capacity, 2·1 per cent. greater efficiency, 5·85 per cent. (40·4°) lower flue temperature, 3·9 per cent. greater proportion of ash, and 2·82 per cent. less cost of evaporating 1,000 gallons.

Moreover, the McKenzie steam blown air syphons used 2·16 per cent. of the steam produced in the boiler, so that the available evaporation was really 5·99 per cent. in favour of the Hawley furnace.

In the maximum capacity tests for equal draughts, runs of six hours were made. The McKenzie furnace showed 7·02 lbs. of water evaporated from and at 212° per lb. of coal, which was 13·4 per cent. greater than the Hawley furnace output. It showed 23·4 more horse-power, but 8·6 per cent. less proportion of capacity developed. It showed 7·3 per cent. greater efficiency, 8·12 per cent. higher flue temperature—possibly a good sign if it meant less useless air, 1 per cent. more ash, and 12·3 per cent. less cost of evaporating 1,000 gallons, or, allowing for the steam used at the blowers, actually 10·99 per cent. in favour of the McKenzie furnace. The coal burned was 39·23 pounds per square foot, with a draught of $\frac{9}{16}$-inch in the Hawley furnace, while the maximum coal burned in the McKenzie furnace was 34·27, but the double grate of the Hawley furnace must be considered in this connection, it being so easy to rake down a lot of stuff upon the lower grate, and get away with much more coal.

Though with neither furnace was there any particularly good evaporation, the maximum under the economy tests being only 7·26 lbs. from and at in the Hawley furnace, still the fuel was of low quality and under 12,000 B.T.U. capacity. Were these two the only possible furnaces, the results are from no side so favourable to the Hawley furnace as to warrant the complication of the double and down-draught grate, and the McKenzie furnace is so distinctly better in the maximum tests, and shows so much better chimney pictures, that there should be no difference of opinion as to the better furnace all round. The principle followed in the McKenzie furnace is good, and might be made use of by putting brick arches in the furnace itself rather than in the flues only. The principle of the refractory lined furnace is bound to obtain recognition in due time. At present its advance is checked by the hurry with which the heat is snatched from the burning fuel, as though, if not at once abstracted, it could in some mysterious way or other get out of the boiler without giving up its heat to the water. The usual error is the placing of brickwork beyond the furnace, as in the McKenzie furnace described, and as also carried out in the Hawley furnace, as an additional safeguard. When put in the flues, masses of fire-brick serve to reheat gases that have become cooled by the action of the water-cooled plates surrounding the furnace. Where the furnace itself is protected by fire-brick arches the gases are completely oxidised before being cooled, and may then be cooled as rapidly as is possible, but it is a mistake to cool the nascent gases and then reheat them, for, under certain circumstances there is not always sufficient heat in the fire-brick to effect this.

PAYMENT OF FIREMEN.

Our New York contemporary, *Machinery*, has an article dealing with the question of paying firemen and enginemen which may be read with interest and profit by both employers and employed. It is very true that many employers think nothing of their engine room staff beyond the fact that they shovel coal and keep the engine going. They are so ignorant of the real conditions of steam engineering that they see no difference between shovelling coal and filling a cart with gravel, and it is probable in the end that the coal which is shovelled for them actually receives no more careful handling than if it were gravel. Pinching wages at the boiler end of the business is a poor business, and one very likely to end disastrously. The writer of the article, Mr. Wakeman, carefully warns all firemen, whose misfortune it may be to find themselves in such a poor place, not to bring themselves down to their employers level by working only to the value of their pay. This is good advice, though it requires a good deal of mental discipline for a man to work to the tune of 30s. when he only receives 20s. The chances are that if a man can act up to the better ideal he will be someday found by an employer who can appreciate the quality of his work and will pay him decently for it. An employer will not readily engage a man out of a dirty boiler house to take charge of a clean one. Therefore let every man take the same care of the machinery in his charge as though he were paid decently for doing so, however hard he may find it, in the meantime keeping an open eye for better work, for there is no hope of a constitutionally mean man who has made up his mind to a certain small limit of pay beyond which he will not budge. Men of this stamp will add large indirect expenses to the cost of their manufacturing charges, simply in order to show losses on their work. The writer knows of a works where, for several years, every piece of work has been declared a loss and yet the partners owe nothing and draw handsome salaries and profits. The farce is kept up entirely to discourage the staff.

The habit of meanness often defeats its own ends. We once knew of a fireman who attended five boilers and burned 80 tons of coal per week. In addition, he wheeled his own ashes to the dump, and was allowed to leave because his employer refused a civil request for an additional 2s. per week. The two men who were necessary to follow him were, of course, more costly in wages, and they were also several tons worse in coal. We have found some few works where a steam heated bath was provided for the use of the firemen, and we believe such provision pays. Stoking at best is a hot and dirty job, and good English stokers are not, as a rule, Svengalis.

While on the subject of stoking, we would emphatically protest against the habits of architects. Nowadays an architect plumes himself upon being quite an engineer, yet he betrays himself and his paucity of engineering knowledge when he has to build a new building and puts the steam boiler in the dampest (we had almost spelt it with a *d*) hole he can find in the lower basement. He provides a concrete ceiling almost low enough to serve as a weight on the safety valve lever. Sometimes he is so kind as to provide a sump to serve as a means for baling out water collected from the flues, which ought never to have even a suspicion of dampness about them. The water tube boiler is supposed to have a particular suitability for such situations by reason of the smallness of its parts, but we have seen places where even these have had to be built in their places and will be impossible to remove without structural alterations to the building. But even in discouraging situations like these we have found firemen doing their duty well, and would commend to all steam users the consideration of the fireman as a coal economiser. An underloaded fireman is apt, like an underloaded engine to be uneconomical. The fireman who is loaded almost to the healthy maximum limit is apt to be economical, for he endeavours to reduce his work by taking care of coal, and several per cent. can be saved over ordinarily good stoking by special care, such as avoiding thin places in a fire, or bare places just inside the firedoor where the grate is often apt to be badly covered. The wages of a man who is burning thirty or forty tons of coal per week are a matter of very small moment indeed. We are perfectly aware that sentiments such as we have expressed are apt to be discountenanced, but, as Mr. Wakeman tersely puts it, it is a matter of dollars. There are few businesses where so large a responsibility in the use of a valuable commodity are entrusted to a man of so modest a salary as a fireman. He may easily be called on to destroy coal to the value of a couple of thousand pounds annually in boilers worth the same amount. The bill for water alone will be greater than his salary. The cashier who at a year's end was 10 per cent. out in his accounts, would be looked upon with grave suspicion. Not so the fireman. He may burn 10 per cent. more than he ought to do, and show nothing for it, and his emyloyer be no whit alarmed. There must be some remedy for this; there is, but it is difficult to persuade men that they can improve on the conditions under which they conduct their works.

GAS AND ELECTRICITY.

Before the recent meeting of the Eastern Counties Gas Managers' Association at East Dereham, Mr. Troughton read the following paper, reported in the *Gas World*, entitled "Electricity *v.* Gas as an Investment for Towns":—

It occurred to me, after I had had several disappointing letters from our members declining to read a paper or to get up a discussion, that I might give you a few figures relating to the growth of the Newmarket Gas Company and its relation to the town as an investment, with the view of raising a discussion. Briefly, I may say that we are threatened with the electric light, first by a private company, who gave notice to the Board of Trade, last October, of their intention to apply for a provisional order, and, secondly, by the local authority, who have decided to oppose the company, because in years gone by they (the local authority) missed acquiring the gasworks and the waterworks, which have turned out such good investments. Consequently, they made up their minds the other day to apply to the Board of Trade for a provisional order so as not to miss any more good things; and they will apply, I presume, next autumn. This opposition has, of course, stopped the private company.

In passing, I may say that our town surveyor estimates that an electric installation costing £10,000 can be put down in Newmarket and worked at a profit of £600 per annum. That 6 per cent. will be very nice when they have made it; but we hear of so many electric concerns that earn nothing at all, and so few that earn 6 per cent., that we may be excused for being somewhat dubious. I know several large towns that are supplying electricity at a loss.

The point I want to bring before you is that a gas company in a small or medium sized town, with a growing business, is a better investment to the consumers of gas, who are the ratepayers, than an electric light installation is, whether it be supplied by a company or by the local authority. We now make and sell more than four times the quantity of gas that we did 20 years ago, and are selling it at 2s. per thousand cubic feet less than we were then. I will give you a short statement of the growth.

In 1875-6	we made	11½	millions	and sold it at	5s. 10d.	per 1,000.	
„ 1879-80	„	17¾	„	„	5s.	„	
„ 1883-4	„	22¾	„	„	4s. 6d.	„	
„ 1889-90	„	36¼	„	„	4s. 2d.	„	
„ 1894-5	„	36½	„	„	3s. 10d.	„	

This reduction in price is entirely due to the expansion of the company's business. The difference between 5s. 10d. and 3s. 10d. means that on our last year's sale of gas over £4,200 per annum was given back to the consumer by way of a reduced gas bill, and this sum will go on increasing as the company's business does. Besides that, we have paid dividends for several years of 10, 11, and 12 per cent., and the last dividend was at the rate of 12½ per cent. upon all our capital.

Last year we applied for and obtained a special Act of Parliament, with the sliding scale and auction clauses inserted, which provides that all new capital shall be sold by auction or tender; and we expect to raise the £15,000 new capital authorised at about 4 per cent., and the £15,000 loan capital authorised at 3¼ per cent. We are at present offering £5,000 debenture stock at 3¼ per cent., which will be expended on extensions as the demand arises. You will thus notice that we have power to raise £30,000, which we expect to get at from 3½ to 3¾ per cent., instead of allotting it amongst existing shareholders at par, as formerly, and paying the usual 10 or 11 per cent. dividend upon it. There is a great saving here, and it affects the consumers of gas very considerably, for if this capital is properly laid out on extensions it should earn, and, I think, will, 12 or 13 per cent. After paying the interest on it there will remain 9 per cent., which on the whole new capital will amount to £2,700. That will be apportioned under the sliding scale as follows:—73 per cent., or £1,964, will go into the consumers' pockets annually, instead of to the shareholders, as formerly, and only the remaining 27 per cent., or £736, will go to the original proprietors. I think this gives the consumers of gas a very large interest in future extensions and developments of the gas company, which, to a very large extent, is carried on for their benefit, so far as future business is concerned. And the consumers are the general public, for, with the aid of the slot meter, we shall soon have every one using gas.

I think a town that has quadrupled its make in twenty years, and reduced the price 2s., may reasonably be expected to double again in 15 years; and at our present rate of growth we estimate that we shall do so. Assuming that we do so, and are selling, in round numbers, 100,000,000 cubic feet, which I do not think an extravagant estimate, then we ought, owing to the growth of the business, the benefit we shall have from cheaper capital, and the economies in production that follow growth—I say we ought to be selling gas at 2s. 6d. per 1,000 cubic feet, which on a sale of 100,000,000 would mean the enormous sum of £6,666 being returned annually to the consumers of gas in the shape of reduced gas bills. That is, of course, looking ahead some 15 years, but I will come nearer home. That large sum of money will be given back to the consumers by degrees; they will not have to wait 15 years. Suppose that we are enabled next year to reduce our selling price of gas by 4d. on a sale of 46,000,000, the consumer of gas would get £800 in a reduced gas bill. So you see that the public have the prospect of getting almost immediately a further reduction of £800 per annum, which is more than our surveyor estimates he can earn from the electric light.

But suppose the electric light steps in and prevents us extending our business as we are doing at present. It may have the effect of keeping the price of gas at its present figure, and instead of the gas company giving to the town a reduction equal to £800 per annum, the town itself will be the cause of the loss. But it may go beyond simply keeping the price of gas at its present figure. It might have the effect of causing the price of gas to be increased, for a company selling gas under the sliding scale may increase the price. Substantial reductions can be made in the price of gas only where there is a growing and increasing business. I do not, however, wish you to infer that there should be no electric light in our towns, because I think that in many towns there is plenty of room for both; but in our small towns, in the Eastern Counties, for instance, I think figures such as the above should be laid before the public before they are rushed into a heavy expenditure to supply the electric light. We can all work out these facts as they apply to our own towns, and they should be forced home to the consumers and ratepayers when they are tempted with a glowing electric lighting scheme, for it can generally be proved that they have already a far better source of income

in the gasworks than can be offered by electricity. Besides, the electric light may not pay, even in the hands of the local authority; on the contrary money is lost, which is made up out of the rates, and the poor ratepayer has to pay his quota to maintain a light which at present can only be termed a luxury for the well-to-do; thus the many have to help to keep the electric light going for the few. I know several of our members have matters relating to this subject before them at the present time, and if they will discuss them, and give us their experience, I shall be glad that I brought the matter before you to-day.

In conclusion, I think that with such a large interest in the local gasworks, as they undoubtedly have in nearly every town, the public should be slow to embark on a new enterprise which, as we all know, so seldom pays its way, and which, on the other hand, may prevent the gas company from conferring such large benefits on the town as I hope I have shown can be, and generally are, conferred by a growing gas concern, whether it be in the hands of the corporation or of a company.

A discussion followed, in which Messrs. Dixon, Smithard, Barton, Sharman, Shadbolt and Ellis took part, and a vote of thanks was passed to Mr. Troughton for his interesting paper.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

At the ordinary general meeting of the Institution, held at 25, Great George Street, Westminster, on Thursday evening, April 16th, after the transaction of the usual formal business, the discussion was taken on the paper of Mr. Dane Sinclair on "Telephone Exchanges and their Working."

Mr. Kingsbury said Mr. Sinclair brought forward two rather important questions with the view of improving the telephone service, and, to some extent, reducing its cost. Those were the two points which he thought formed the essence of the paper, and he wanted to say that those were two points upon which it was impossible to hold other than one opinion. They must all be in entire sympathy with Mr. Sinclair in his aims, and recognise fully that he desired to attain those results which he had mentioned. It was open to some of them, perhaps, to feel that there were other ways of attaining those results, and they might even go so far as to remark that, by Mr. Sinclair's methods, he did not attain the results he aimed at. He (the speaker) found it impossible to take up the position which he did take upon this matter without recognising fully the aim which Mr. Sinclair had in view. Coming to the discussion of the paper, in the first place he would refer to the call-wire system. Of course, the call-wire system was by no means a novelty. It was described in that room by Sir Frederick Bramwell on March 1st, 1883, when he said, "The Law system seemed to me to work extremely well when I saw it in operation in Philadelphia," and that opinion was an opinion that was held by a great many others at that day, and he was sure that amongst those who held it, it was consistently held and reasonably held, and was, curiously enough, the result of their experience. He did not think he had ever come across an advocate of the Law system—that was practically the call-wire system—who had not consistently held that it developed the service. But they had to consider that some experience had been gained between 1883 and 1896, and it happened that the system which Sir Frederick Bramwell saw at work in Philadelphia was now in process of being discarded there. In October, 1883, Mr. Lockwood was attending a convention in St. Louis; it was quite impossible to deal with any question of early telephone history without quoting Mr. Lockwood. The Law system was under discussion then, and Mr. Lockwood said, "About a couple of months ago I was in St. Louis where the Law system has been in operation for some years. St. Louis, although a city of very large population, has a very small telephonic population. Whether there is any connection between the two things, the Law system and the sparsity of the telephonic subscribers, I am not prepared to say." In looking up that extract a suggestion occurred to him which he followed up. He looked up the English records, and there were some very full records in the committee's report. Perhaps he expected to find that the English towns were also sparsely populated telephonically, but he found that it was not so. The towns using the Law system stood at present very well on the list of those towns that had a fair number of telephone subscribers. But he found one set of records in this committee's report, a statement showing the number of subscribers in the four large Scotch towns during the last five years. Of these towns Dundee and Aberdeen had been using the Law system during that period; one of the towns, Edinburgh, had been using the indicator system, and another, Glasgow, had been using both during the period. Now, the number of subscribers in Aberdeen during the last five years had increased 82 per cent., Dundee had increased 57 per cent., and Edinburgh 140 per cent. That was not enough for them to assume that it was in any way a conclusive comparison. He had not had an opportunity of consulting other towns, and four towns were not sufficient to afford a proper basis of comparison. Still there was the fact, and he suggested the comparison in order to see how it came out with other towns of equal character. In Glasgow, since the Law system was introduced, the proportion of increase had considerably fallen off; but there again the time (two years) was not long enough to enable them to judge fairly. Five years might be long enough to strike an average, but two years was not. In Philadelphia the Law system was now in process of being discarded, and in St. Louis also it was about to be discarded. These were points peculiarly adapted to consideration on the subject of this paper. Another thing he looked at from the statistical point of view was to find the extent to which subscribers used their telephones on various systems. He found that Glasgow had 6½ calls per day per subscriber; in the records they appeared as messages, of which there were thirteen, but Mr. Sinclair, as well as himself, was accustomed to deal with effective calls, and he put that down at 6½ per day. That was another point they had to consider, if the Law system was considered useful to subscribers they must consider how much they used it. It appeared that all the exchanges using the Law system were somewhat below any other town of their size in the United Kingdom. In any case the subscribers did not use the telephone to the same extent they had on the indicator system. It was quite useless for him to suggest reasons for that; they might go on talking for a long time and have many different opinions expressed on it: he simply gave them the facts. Mr. Sinclair referred to the difficulty in connecting between exchanges, of making trunk calls. He supposed the thick and thin advocates of the Law system would say that difficulty did not exist. But they knew that it did, and its existence seemed to him rather a reason for not pursuing the Law system. If they were to indulge in any ideals at all they ought to have an ideal that the communication between towns in the sweet by-and-bye would be as easy as the communication between streets of one town now, and if there was any difficulty it seemed to him something of a reason for not pursuing that system. Mr. Sinclair said that 95 per cent. of the subscribers appealed to in a certain exchange preferred the call wire system to the indicator system previously in use. The weak point about that was that they had not the whole of the material before them to enable them to make up their minds. The question was, What was the indicator system previously in use? When they had that information, they could estimate the value of the subscribers' opinions. Personally, he attached more value to the opinion of Mr. Sinclair as that of an engineer; the opinions of the subscribers was rather a weak argument. Subscribers ought to be treated rather as children; they did not know what was good for them. The people who supplied them should tell them what they ought to have, what it was best to give them, and not necessarily what they would like to have. If they asked the subscriber what he would like, he would probably ask for something that was not good for him. The next important point in Mr. Sinclair's paper was the question of flat boards. In regard to flat boards, Mr. Sinclair remarked somewhere in his paper that they had been in use previously, and as they were not used for saving spring jacks, it was difficult to see what they were installed for, excepting that they were more easy to operate. That was rather begging the question. They would have to consider presently what the facility of operations was, but he thought it was possible to find another reason for making flat boards without suggesting that they were easier to operate. Flat boards were originally introduced on the Law system, before the introduction of the multiple switchboard. At that time it was necessary to have inter-communication by what was called "cross connections" between one set of subscribers and another. In that case, the lines ended in plugs placed in the middle of a switchboard with connecting bars across, in which two plugs were put in order to complete the communication. If they could be connected on that board, they saved the cross-connecting with another board, and simplified the trunk line difficulty. Now, if they could have a number of plugs along the middle of the table, and operators on each side, they could reduce the number of cross-connections. That was, at first, the advantage of the flat board; subsequently, when the Law system was extended so as to use the multiple switchboard, the jacks were reduced to microscopic size, more or less like honeycomb, and the operators were given the whole of the jacks in the exchange. If that pointed to anything, it pointed to the difficulty of one operator passing another on the flat board, and that was one of the difficulties he would have to refer to presently. Well, after the introduction of multiple switchboards with the object of saving jacks, they had the switchboard of Mr. Hawes in 1884; then the next was the design made by Vail and Seeley, and described in their patent of 1888, and really the number of spring jacks they claimed to save was simply fabulous. After that they had the design of Messrs. Jackson & Sinclair, and shown in their patent of 1889. Vail and Seeley saved an immense number of jacks—double the number that Mr. Sinclair did—they said; but, as a matter of fact, it was exactly the same number. They made the board of a different design, and took a different standard, and the result was that they made a very good showing. What he would like to point out was that these comparisons on paper of the upright board with the flat board had one disadvantage, and that was that they assumed you might take anything from the upright position and place it in a flat position, and have similar facilities. They had only to consider what would be the difference to them if the diagrams before them were taken down from the wall and placed on the table; they certainly would not be able to see them so well. If they applied the same argument to the black board, they would be getting very near the conditions with switchboards. If anyone would try to cover that black board, lying flat on the table, with chalk marks, they would find it impossible. He therefore wanted them to see that the different comparisons of this paper were not founded on fact, but were based on a wrong assumption, and he would remark that the controlling factor in this matter was not electricity at all; it was simply anatomy. If they would regard the hand as the extremity of a lever, of which the shoulder was the fulcrum, they would see that the hand could describe a complete circle moving in a vertical direction, and in a horizontal direction only a semi-circle. The result was the multiple switchboard, upright, had double the capacity of the multiple switchboard on the flat. That was the governing factor of the whole business. Again, if they considered the hand as the lever, and considered the application of power to that lever, they would find that in the upright position they had a maximum of easy work, whilst in the flat they had a maximum of difficult work. If you struck straight from the shoulder, you got the greatest power; as you got away from

he centre your power was gradually reduced. This was not, of course, a question of lifting heavy weights; but in dealing with a large number of calls, there was an aggregate amount of work done and power expended, which counted seriously in the day's work. The upright board was easy to work, but the flat was difficult, and that resulted in an increased cost of working, and when they got to increased cost of working, they got to the crux of the matter. They might save in the cost of construction, but only at the expense of increased cost of working. There were two points which Mr. Sinclair referred to as the most important, which induced him to adopt the flat board. One was the small number of jacks and quantity of cables used, whereby better speaking results were obtained, and fewer faults occurred. He was afraid Mr. Sinclair had in view an obsolete type. With the multiple form of break jacks (fig. 5 in the paper), it was a distinct drawback to increase the jacks; but that was a reason for not using that apparatus at all. But when they came to the branching system they had a condition of things in which they might multiply their jacks indefinitely, and not incur any real trouble in regard to the speaking results. They had two lines straight through the board; the only difference in those lines inside and those outside the room, was that they had a somewhat smaller conductor, and they had it covered. The only trouble that might arise to affect talking was the trouble that might exist from the reduction of conductivity, and the increase of capacity, and both those conditions they might regard as negligible quantities. The next reason given was the possible difficulty in finding room for upright boards, and the advantage of putting them on the flat, because they practically only took half the floor space required for upright boards. Well, that applied generally. If they took a multiple switchboard under ordinary conditions, with access to the back of the board, they would have a board running on three or four sides of the room; if they had a multiple switchboard on the flat they would have two operating surfaces for the switchboard, but in no case did they double the capacity of their room. If they really wanted to get a large number of switchboards into the room they must use the upright board! The reason for that they would see, taking figs. 6 or 7. In fig. 6 they would see the cable racks went down somewhat deeply in the board. As a matter of fact, in fig. 6 the cable racks were less than one-half the distance across the board—40 inches across and 17 inches down. Put that up on edge and another similar board at the back of it, and they would get two rows for less ground space occupied. The difficulties of detail in working the multiple switchboard when installed on the flat were such that it was not necessary to go into them. But there was one question he might go into; the question of an operator on one side having to read in English fashion, from left to right, while on the other side the operator would have to read in Arabic fashion, from right to left. Repairs were difficult and additions were expensive. Then to come more to the practical question of cost; the comparisons in the paper were made entirely on what he might call old types. It was a question of an operator attending to 50 subscribers. The first multiple board introduced in England had one operator to 50 subscribers. Now they had boards made for 450 subscribers on the upright worked by three operators. A Western Electric branching board of that size was established in Christiania; at the present moment it was not worked to its full number; it had trunk lines on it, and was found a little too much for the operators. Boards of 360, however, were quite common on the branching system; that gave 120 subscribers to one operator. This arose from the facility of working, and that, really, was the crux of the question. They must reduce their operating expenses, taking care, of course, that the apparatus was maintained in the highest state of efficiency. They did it by using upright boards, by making them fast, by giving as many facilities as they could to the operator, and reducing their whole expenses. The difference was merely a question of saving the first cost, or saving the working expenses.

Mr. G. Binswanger said he was glad to see that Mr. Sinclair was adopting an independent line in telephone exchanges. He had given them in large centres like Manchester the flat board and the call system. He might say he had had his doubts, like many others, as to how the public would take to the call system, but from experience he could endorse everything Mr. Sinclair had said upon this subject, and that in spite of the remarks of Mr. Kingsbury. They had occasion in Manchester to use both systems, the call system and the annunciator system, side by side. His own experience, and that of most of the subscribers whom he had consulted, was that the call system was preferable. They felt that they were in more direct communication with the exchange as well as with the subscribers. They certainly got a much quicker service, which, after all, was the principal thing. This also showed that the subscribers do not mind the extra work caused by the call system, and led, in his mind, to the question whether they could not put still more work into the hands of the subscribers, and thereby reduce the work at the exchanges, making them more automatic. They had heard a great deal lately of automatic exchange systems, both in England and in America. He understood that an automatic exchange was actually in operation in several centres in America, having subscribers up to the number of 200. No doubt Mr. Sinclair had investigated those automatic systems, and it would be extremely interesting and useful if they could hear from him what he thought upon that subject. He (the speaker) did not ask the question to learn whether he would ever adopt them in his own exchanges, but there could be no doubt that if an automatic system of exchanges could be devised, which was both simple and reliable, it would be extremely useful in small exchanges, and especially in private exchanges, in works, and in large establishments. Mr. Sinclair, in his paper, referred several times to American practice and American invention. No doubt most of the apparatus and appliances which they were using in telephony, and especially in exchanges, had come to them from America. This fact might give the impression to outsiders that American telephone engineers were more ingenious or more enterprising than they were in England. But they all knew that that was not the true explanation. The fact was simply this, as they knew, that the first proprietors of the telephone patents had killed the industry in England in the early days. Those who knew the history of the telephone would agree with him, he believed, if he said that the first commercial telephones had been made here in England. Mr. Preece had brought Bell's first telephone to England, and had demonstrated it there in public before it was generally known in America. The telephone industry in England sprang up quickly, and it looked as if the whole world were to have all their telephones from England. The early proprietors had thrown the industry into American hands. They therefore ought, he thought, to be thankful that at the present moment there was at the head of the telephone company a man who would and could adopt an independent course, and he thought they were indebted to Mr. Sinclair for the very opportune paper he had given them, showing them that he would emancipate himself from former practice. Manufacturers in England could now hope to retrieve and regain the ground which they had lost in telephone matters in England, as well as in our Colonies and abroad.

Mr. W. H. Preece complimented Mr. Sinclair and his company on his appearance there. This was the first occasion on which any representative of the National Telephone Company had had the boldness to come before the Institution and to tell them what they were doing. Mr. Binswanger spoke rather strongly of the mode in which the industry in this country had been killed by the early promoters of this particular business. He did not think there was anybody who had ever spoken in severer terms of the management of the National Telephone Company than he (the speaker) had done in that very hall. Its management in the past was unquestionably execrable, but he was happy to say that a complete change had come over the spirit of their dreams in Oxford Court, and now they found this company, so obnoxious in the past, actually doing all it possibly could to repair the evil that had been done. They were now working with an energy and a spirit that would, in the course of a few years, bring the telephone industry in this country into a position that would compare with that of any other land, not excepting America. It had been his good fortune to have seen, perhaps, more of the working of the telephone than most people. He had been over to America three times, had been to Norway, Sweden, Germany, and, in fact, wherever there was anything to be learned. He found that the telephone company—and he simply gathered it from Mr. Sinclair's paper—was taking the cream of what was being done elsewhere, and they were all going to reap the benefit. In the first place they were introducing metallic circuits; and they knew how strongly he felt on that subject. He had said over and over again that the telephone without the metallic circuit was an imperfect and incomplete apparatus, and that any single wire system was deficient and defective. The National Telephone Company were introducing metallic circuits everywhere. Again, they were introducing multiple boards. He disagreed in regard to these with Mr. Sinclair, for his opinion was that their days were numbered. The multiple board was doomed for large exchanges. The experience in America was that as an exchange grew, so did the difficulties of the multiple board in a terrific ratio. There was a limit, and unquestionably an exchange might become too great for a multiple board. The experience in America, in Sweden, and in Berlin seemed to be this, that when they got to 5,000 subscribers the difficulties were so enormous that they must be met in some other way. In the States and in Berlin they were being met by decentralisation. In Chicago particularly, the system Mr. Sinclair had referred to, called the divided board system, had been inaugurated, but in San Francisco there was another system, called the Express system, which was also being introduced in Chicago, and in one or two other places. Up to the present moment, the reports received were satisfactory, and it would seem that sooner or later the multiple board in all big exchanges must give place to the Express system. He quite agreed that up to 2,000 or 3,000 subscribers nothing could be better than the multiple board. Mr. Sinclair, in his paper, had spoken a good deal on the question of trunk work and its difficulties. On that point he was not prepared that night to speak. They had only within the last week or two transferred to the Post Office from the telephone company the whole trunk system of this country, and it would take some months before it would be thoroughly licked into shape. He hoped by the commencement of the next session they would have in this country the finest telephone trunk system in the world, and he also hoped that the session would be commenced with a paper written by Mr. Gavey describing that trunk system, and how it was being worked. Mr. Kingsbury had criticised a great deal the observations that Mr. Sinclair had made on the call wire system, or what he called the Law system. The latter system, worked on a large scale, had its difficulties. He entirely objected to it for exchange working, for the simple reason that it was absolutely unnecessary. In fact, he could not understand, with the experience they had had, the use of any call system or any mode of calling attention, whether by the magneto or by the Law system. In the Post Office they never had such a system. Their call was automatic, if they could call it a call. When a subscriber went to his telephone and lifted it off the switch, he called the exchange by a visible or acoustic signal, and when he had finished his talk and replaced his telephone on the handle again, there was the ring-off. Both the call and the ring-off were absolutely automatic, absolutely perfect in action. It had only one objection, and that was a very strong objection with those who had not tried it—it was not an objection to those who had tried it—and that was that it involved the use of a continuous current. The idea of having a battery running continuously on a subscriber's line was like a red rag to a bull, to the old telephone man. But to a new telephone man and to the Post Office it had no terrors at all. He was happy to see from the representations from America, that they were introducing a visual system, which would have all the benefits of the system they had introduced in the Post Office. Mr. Kingsbury had also criticised

Mr. Sinclair's views on flat boards *versus* vertical boards. He (the speaker) had a serious objection to flat boards. There was a certain amount of attractiveness in the appearance of a flat board, and there was something about it that was enticing. But his objection to it was purely a practical one, and that was the difficulty that the engineer had in removing faults, and the difficulty of making any changes behind the board while the operators were at work. With a panel or a vertical board there was absolutely no difficulty. The operators proceeded in the ordinary way, and the engineer went behind, examined his wires, his contacts and his springs, and he could alter and change and shift, without anybody in front having the least idea that there was anybody behind. In fig. 7 that would be difficult and awkward, when on each side of him the engineer had the knowledge that he was near the pleasant knees of the operators. Behind the board that did not matter. That was a practical objection, and a very serious one to the use of a flat board. There was one other point that he wished to urge, and it was this; they might make their apparatus as perfect as that described by Mr. Sinclair and the apparatus he had seen in use in Sweden and in Berlin. They might have operators as charming as the young lady in the diagram, and also as adept in the manipulation of her plug and jack, but unless they had subscribers who were equally clever in the manipulation of their apparatus, unless they had subscribers who took an interest in the telephone work of their exchanges, unless they had subscribers who would co-operate with the telephone company, or the Post Office department, or whatever administration it might be that did the work; unless they got mutual forbearance, mutual assistance and support from each side, they would never create satisfactory telephone working in this country. There was a considerable difference in the mode of working in Sweden and in England. But there was also a strange difference between the working in London and in Germany. He could say without the slightest hesitation that there was no place that he had ever visited where the telephone work was better done than it was in Berlin; and they had it well done there, even on a system that was technically defective. It was a system consisting of a single wire, and where they used practically obsolete apparatus; and yet there was the fact that in Berlin, at the present moment, the telephone work was better done than in any town he had ever seen, either in America or in Europe. The reason was this, that there was absolute co-operation between subscriber and operator. Half the work was done by the subscriber. Here in London, and in most places, the subscriber called, was answered by the operator, told who was wanted, the operator tested the line wanted, called the first subscriber and put him through, and there were two or three operations performed unnecessarily. Now in Berlin you called the exchange, stated the number you wanted, and the operator simply said, "Please call." You were at once put through to the subscriber for whom you had asked, and you yourself, the subscriber, called the friend to whom you wished to speak, and learned whether he was in, or had left the business to the office boy. You could thus bully your brother subscriber, and not the poor operator girl, who in my experience always did her best to do the service of the company with smartness and zeal.

(*To be continued.*)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Compiled expressly for this journal by W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

NEW PATENTS.—1896.

7,358. "Improvements in process of nickel plating." H. L. Haas. Dated April 7th.

7,380. "Improvements in telephone transmitters." W. L. Wilhelm and B. J. Tillman. Dated April 7th.

7,475. "Improvements in electrical pilot or shallow water signals for vessels." H. H. Franklin. Dated April 8th.

7,484. "Improvements in electric meters." Eversheds & Vignoles, Ltd., and S. Eversheds. Dated April 9th.

7,530. "A new or improved electrical alarm apparatus." G. H. Atkinson. Dated April 9th.

7,556. "Improvements in electric railways." H. C. Reagan. Dated April 9th.

7,557. "Improvements in commutator brushes and brush holders." R. Hirsch, M. R. Hirsch, and J. F. Trottmann. Dated April 9th.

7,588. "Electric ram lift." T. Meacock. Dated April 10th.

7,621. "Improvements in electric switches or apparatus for connecting electric circuits." J. D. F. Andrews. Dated April 10th.

7,622. "Improvements in insulating materials and their application to electric wires." J. D. F. Andrews. Dated April 10th.

7,649. "Improvements in or connected with electric cables or conductors." H. Edmunds. Dated April 11th.

7,650. "Improvements in wire ropes and armourings or coverings for electric cables." H. Edmunds. Dated April 11th.

7,668. "Improvements appertaining to road vehicles propelled by steam, oil, electric, or like motor mechanism." F. Lister. Dated April 11th.

7,694. "Improvements in or connected with electric traction." F. C. Esmond. (Date applied for under Patents, &c., Act, 1883, Section 103, September 11th, 1895, being date of application in United States.) Dated April 11th.

7,699. "Improvements in lamp posts or holders for electric street lamps and other large lamps." J. Jakoubek. Dated April 11th.

7,716. "An improved connection for electric light cables." R. J. Hatton and W. T. Henley's Telegraph Works Co., Ltd. Dated April 11th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d. (in stamps.)*]

1895.

19,837. "Improvements in electric arc lamps." T. E. Adams. Dated October 22nd, 1895. The lamp has a single electro-magnet wound with a fine wire coil and a coarse wire coil in parallel with the arc. The armature of this magnet controls the clutch which regulates the approach of the carbons. When the lamp is out of circuit the carbons are separated, but when the circuit is made current flows through both the fine and the coarse coil, thus attracting the armature which allows the carbons to approach. As soon as the carbons touch, the coarse coil is short circuited and the armature drops a short distance separating the carbons. The feeding is regulated by the fine coil. 31 claims.

24,706. "System of electric telegraphy and central station connections and apparatus therefor." G. C. Marks. (W. H. Cooley, U.S.A.) Dated December 24th, 1895. Has for its object to provide a direct type printing telegraph, adapted either to automatic or to key transmission without change, and to dispense except in cases of synchronous multiplexing of the work with all synchronous or step by step movements and sunflower distributors and revolving parts, and also the movement of heavy parts in the receiving printer, such as the carriage or keyboard of similar heavy parts in type printing telegraphs when operated by shifting keys or their equivalents and that too while still employing the equivalent of shift keys in a typewriter so as to reduce to a minimum the number of type bars and the work of selecting them. 40 claims.

24,905. "Improvements in and relating to telephone transmitters." T. J. Roeke. Dated December 28th, 1895. Relates to transmitters having two or more microphones constructed of metal or carbon rods which support carbon or metal balls, one or more of the rods of each microphone being carried by a rigid support and the remaining rod or rods being secured to a rigid frame carried by or bearing against a flexible diaphragm. The metal balls or rods are gold plated or platinised. 7 claims.

1896.

156. "Improvements in regulating the supply of gas or electric light to railway coach compartments." H. T. Proctor and R. E. Gill. Dated January 3rd, 1896. The supply cock or switch is actuated by gearing connected with a false seat formed by a batten extending along the top of the front of the ordinary seat and supported on springs. When any person sits on the seat the false seat is depressed and through the gearing actuates the cock or switch so as to increase the light. A spring returns the cock to its original position to lower the light when the seat is empty. 5 claims.

475. "Improvements in electric accumulators." W. C. Bersey. Dated January 7th, 1896. The conducting supports for the active material are made of two similar grids united together at their edges. The grids have apertures in them which are larger on the interior surface, thus preventing the active material from falling out. The plates are supported on pneumatic cushions to prevent jarring and shaking. 2 claims.

880. "Improvements in electric heaters." G. Ewart and J. Vaughan Sherrin. Dated January 13th, 1896. The heater consists of a core of insulating material, with a bare heating wire coiled upon it, the whole placed in an insulating cylinder, with a space between the core and cylinder to permit water to flow through. Entrance and exit pipes are provided for the water which is heated in its passage through the heater. 2 claims.

1,198. "Improvements in electric railways." J. W. Darley, jun. Dated January 17th, 1896. Relates to railways in which a series of conductor sections in the track are successively brought into circuit by magnets carried upon the car. The magnets act on armatures supported on the track and through these armatures operate the switches for the conductor sections. The object of the invention is to cause the magnets to preserve the same relation to the rails whether the car is on a curved or on a straight part of the track. For this purpose the magnets are carried upon guide trucks pivoted to the main car trucks, and when the guide trucks turn on the curve the magnet is caused to move in a direction transverse to the rails so as to preserve the same distance between them. 10 claims.

1,611. "Improvements in and relating to holders for incandescent electric lamps." W. McGeock. Dated January 23rd, 1896. The spring pins or plungers which make contact with the lamp terminals slide within fixed parallel sleeves secured to an insulating block in the ordinary way, and the improvement consists in surrounding these sleeves and the upper portions of the spring pins with a second insulating block through which the pins project. 1 claim.